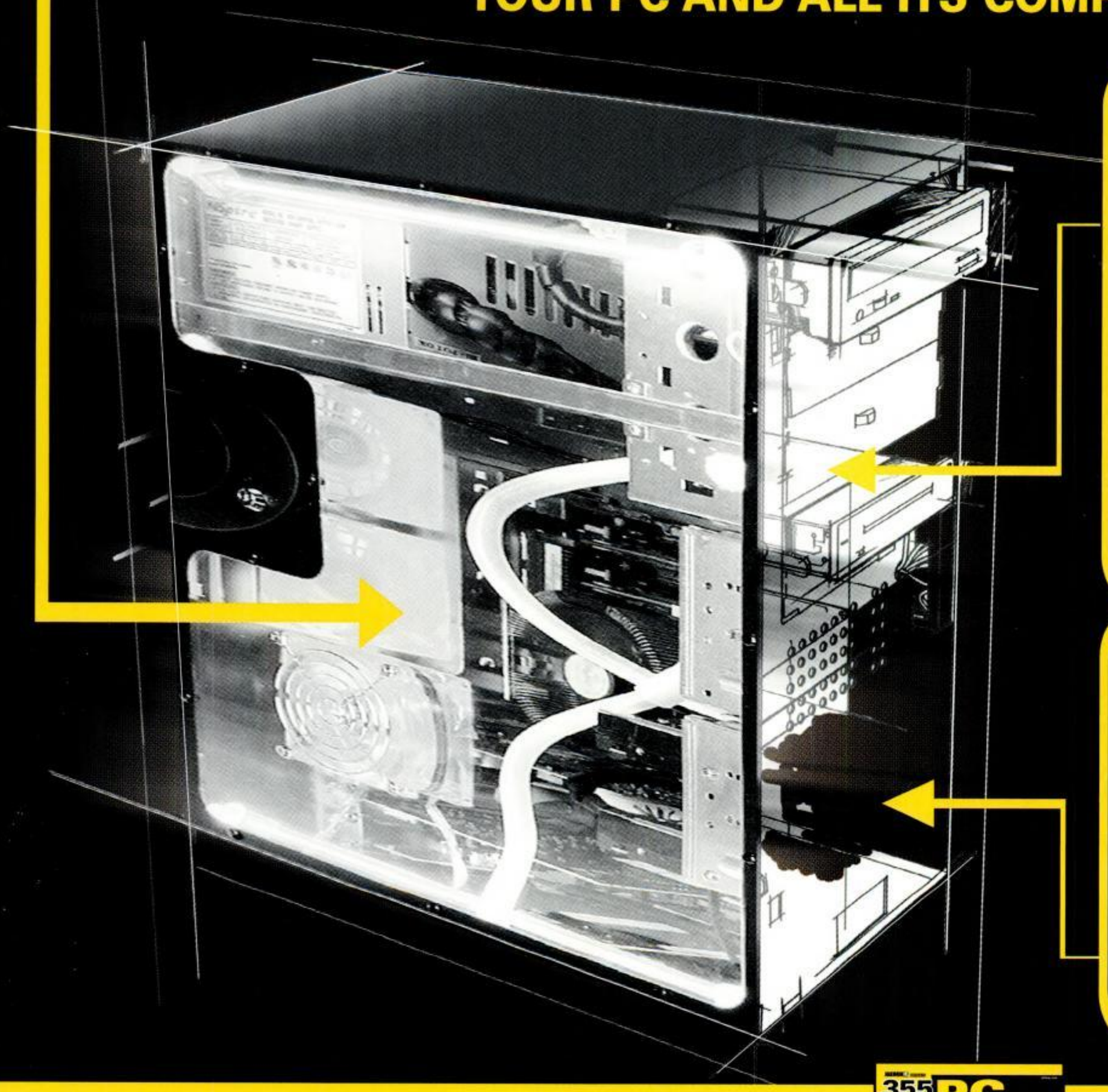
MAXIMUM PC PRESENTS

SPRING 2004

355 PC ANSWERS

THE *ULTIMATE* REFERENCE GUIDE FOR YOUR PC AND ALL ITS COMPONENTS



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Release Notes

The Voyage to Nerdvana Begins Here

Greetings, intrepid shopper, and thank you for buying this special edition of *Maximum PC* magazine. Brace yourself, because you are about to embark on an amazing journey of discovery into the inner workings of that fascinating machine known as the "Personal Computer."

Although the PC may seem confounding at first glance, and even more confusing once you've delved inside its tangled interior, it's really not as complicated as it all seems. This isn't rocket science, but understanding how all the different parts of a PC work together does require a little bit of knowledge, which brings us to the magazine you now hold in your hands.

As the name implies, this issue is all about answering the most common and fundamental questions people have about their PCs. How does it work? What does this part do? How do I fix it? And finally, what can I do with it?

We've attempted to answer all these questions and more. We trust that by the time you finish reading this handbook, you'll have a solid base of information from which to draw when it comes time to upgrade, repair, or simply explain the PC to your computer-illiterate friend. Yes, we are passing the torch onto you! Now you'll be the one all your family members and friends turn to when things go pear-shaped!

Of course, there's a lot more in this magazine other than mere tech support tips. Each section also includes a glossary of important tech terms, technology and upgrading explanations, and how-to guides. We feel it's all a good mix that will turn you into a PC expert by the time you've finished reading.

So dive in, the water's just fine. And please make sure to shoot any comments (good or bad) to me at **jnorem@maximumpc.com**. Thanks for reading!

—JOSH NOREM

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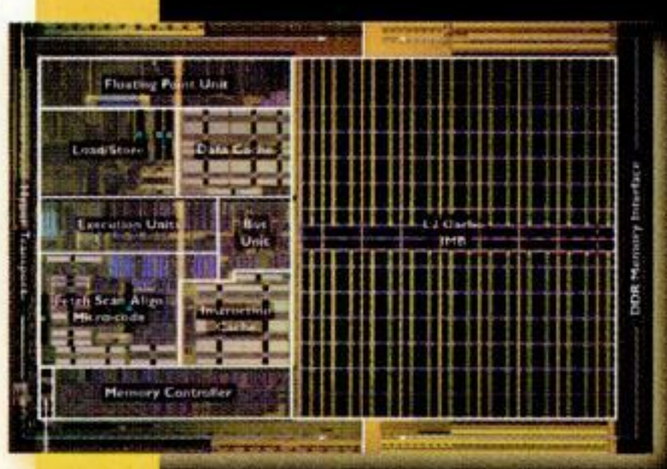
ON THE DISC

The disc is bursting at the seams with software hand-picked by the *Maximum PC* staff! You need these apps and utilities!



10 CPUs & COOLING

What better place to start than with the brains of the PC? Learn what a CPU does, what's on the horizon and how to keep your proc chilly!

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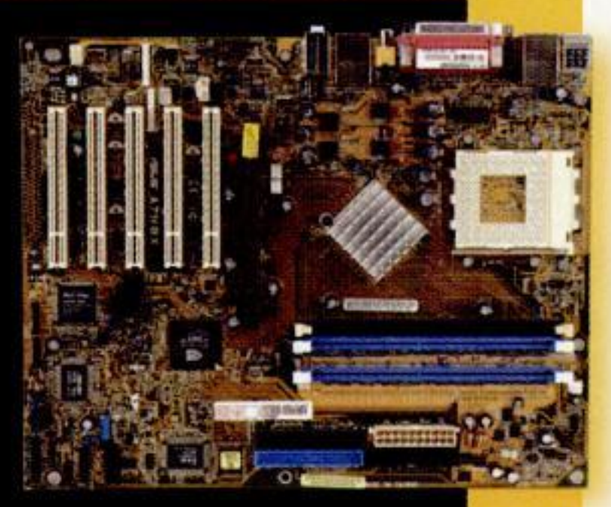
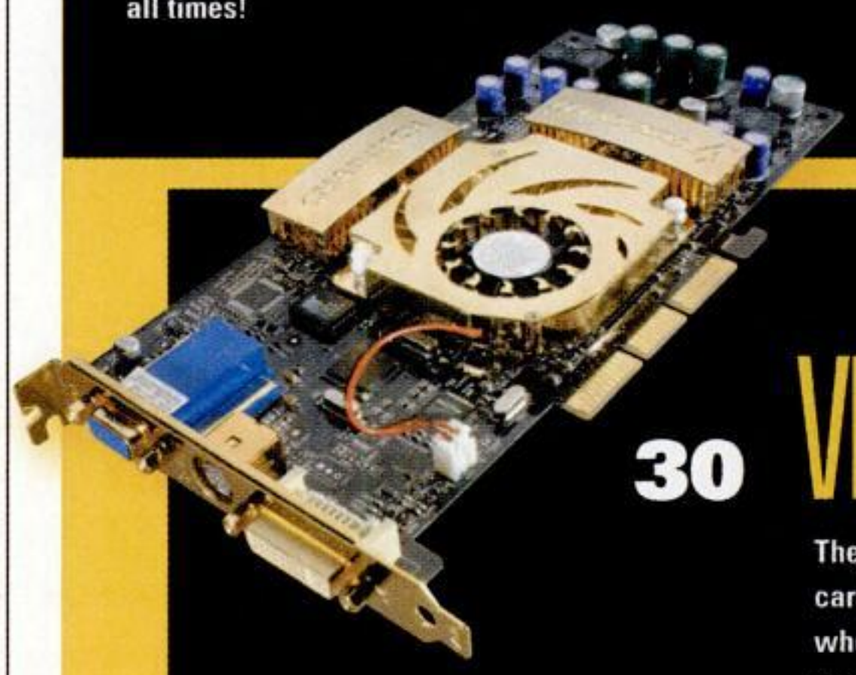
The motherboard is the lynchpin of every PC, since it determines all future upgrading capabilities. Find out what makes it tick, what to look for when making a purchase and how to keep it healthy at all times!





30 VIDEOCARDS

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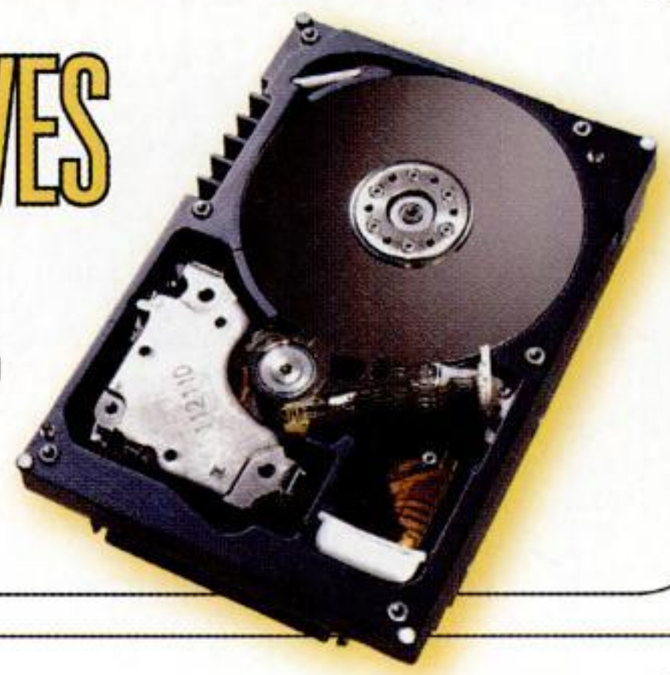
We take the "hard" out of hard drives and explain the technology in plain English. Learn how they work, how to take care of yours, and how to make it faster!



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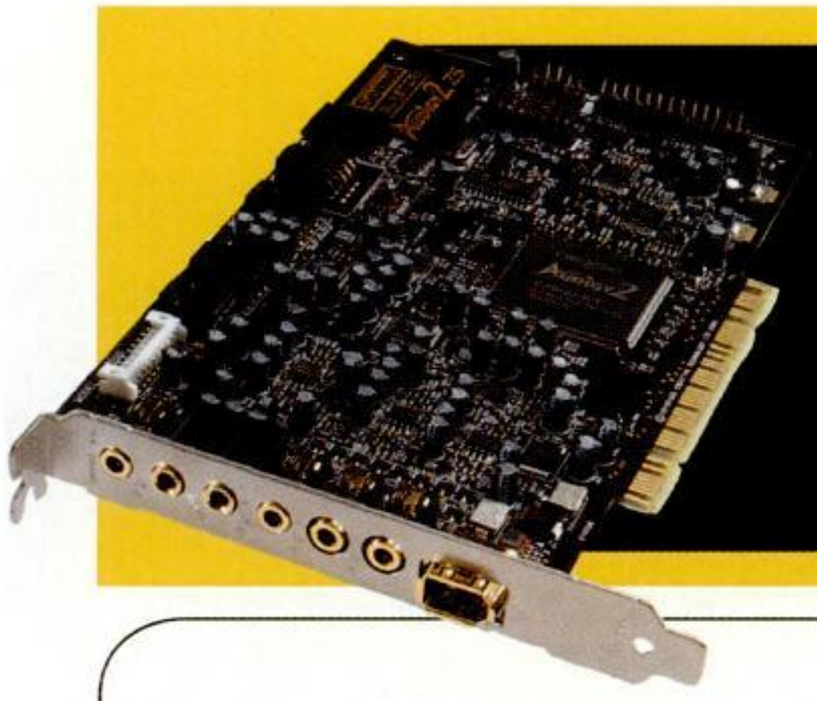

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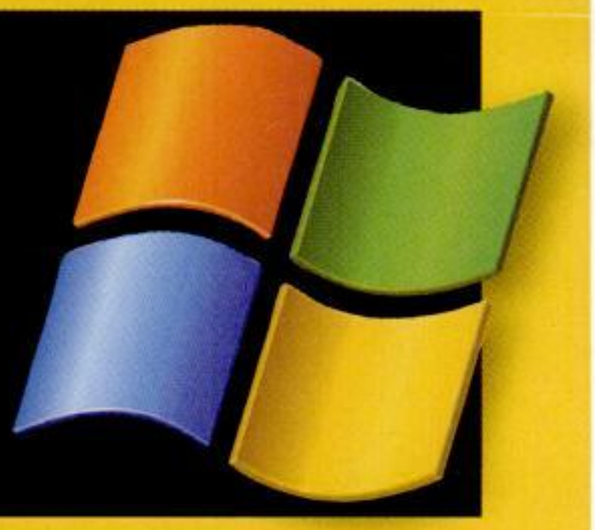

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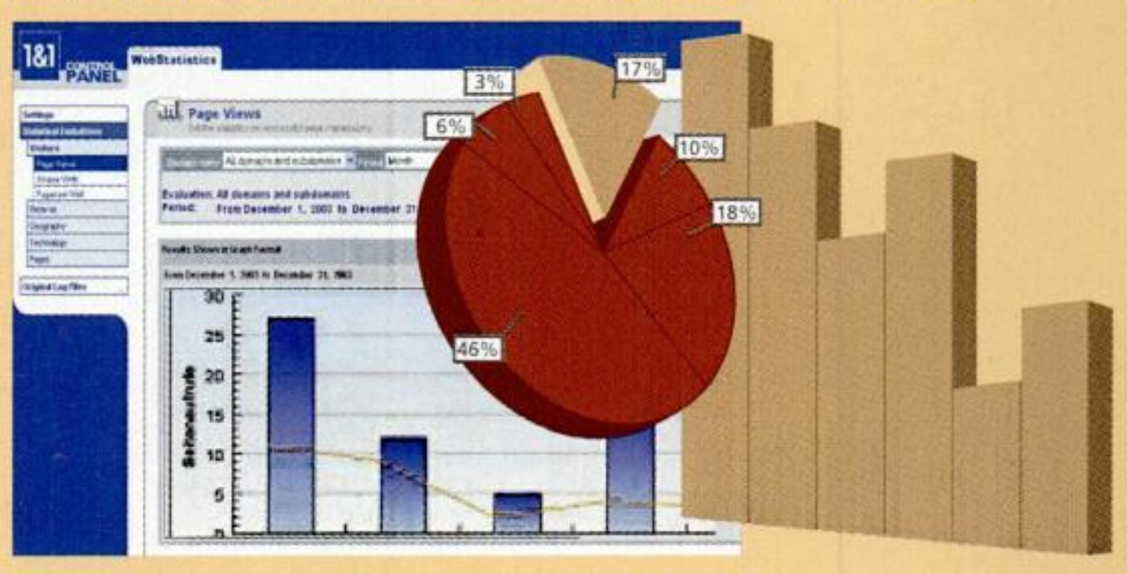

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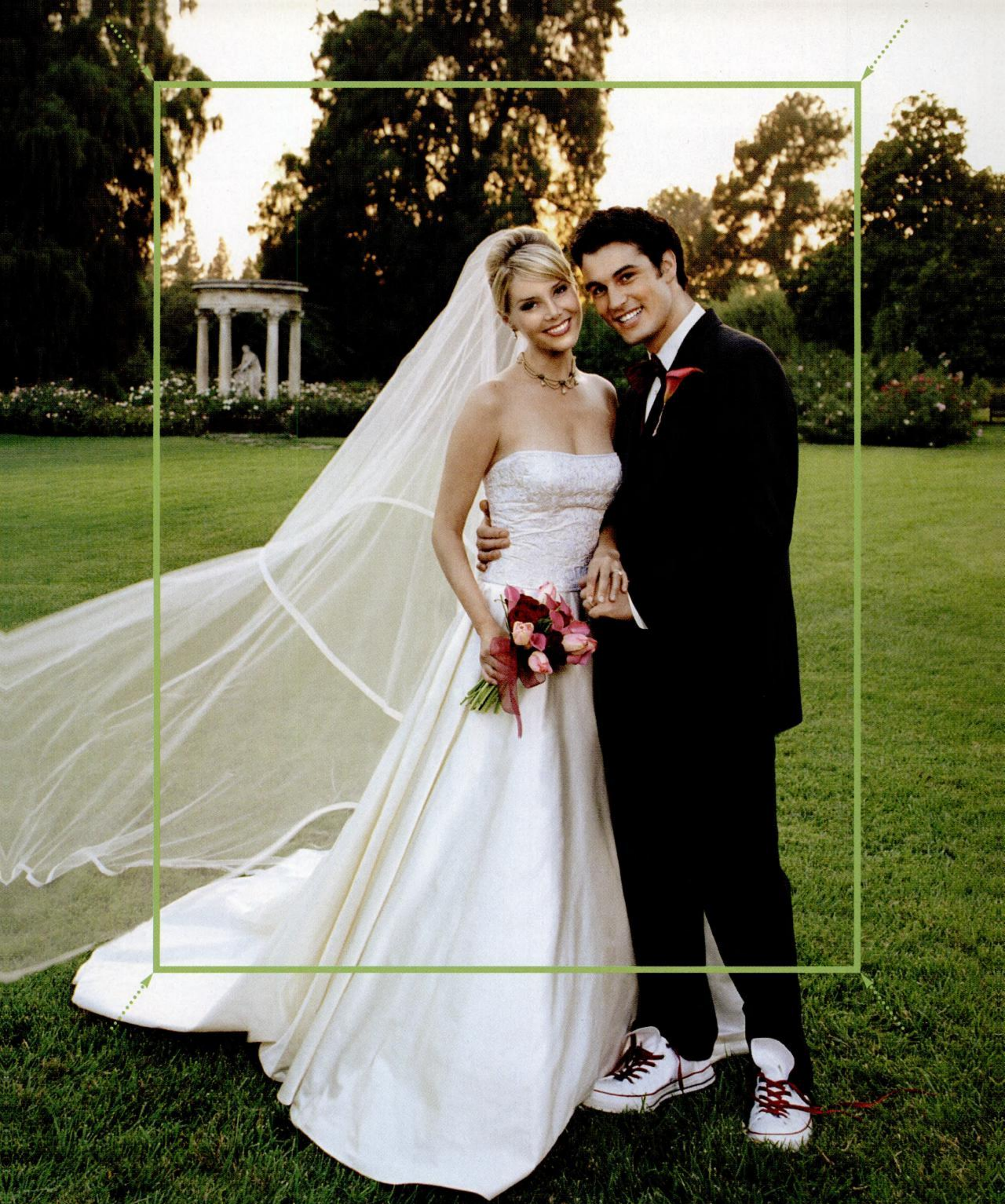

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Q What is currently Intel's finest?

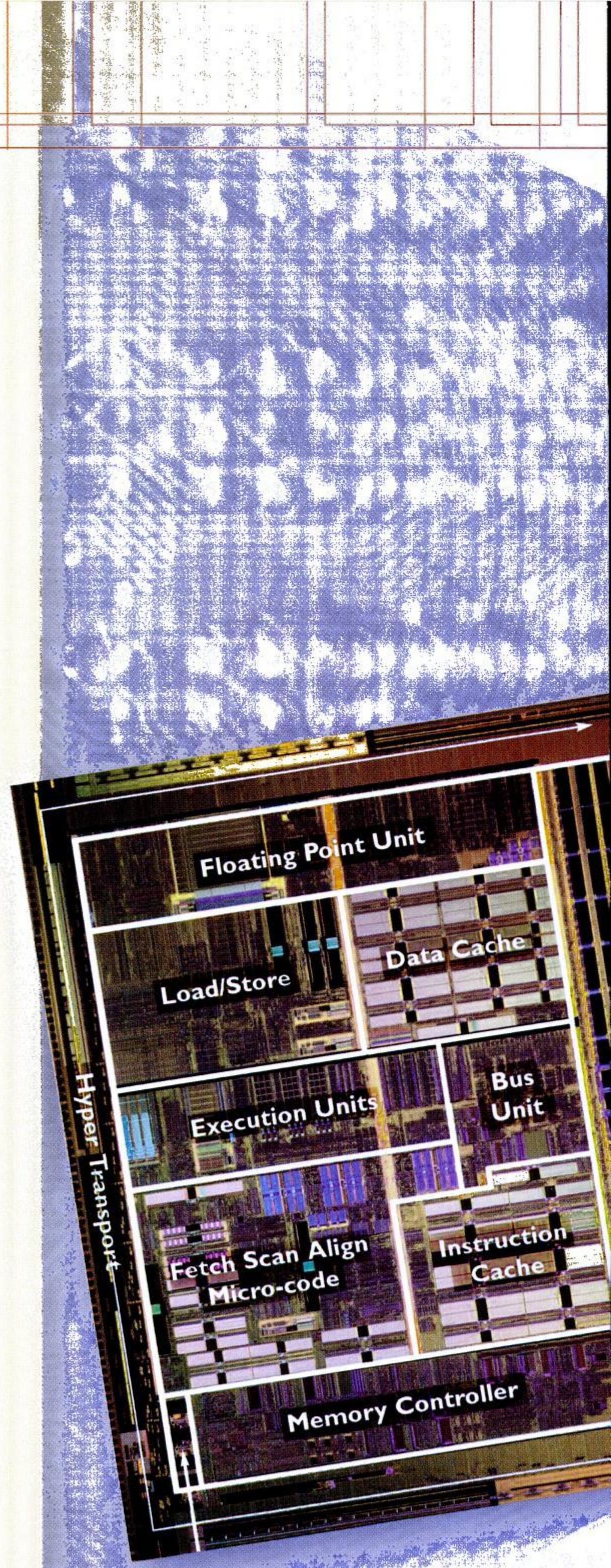
If you're looking for a new CPU, there are only two choices for ultimate performance on the PC: Intel and AMD. Intel is still king of the hill in the microprocessor business in terms of volume, but some would argue that it no longer has a lock on the performance crown. Intel's flagship CPU today is the Pentium 4 Extreme Edition (P4EE), which has transistors that are 0.13-microns thick. This chip packs quite a punch thanks to its 2.5MB of onboard L2 and L3 cache, which is used for storing frequently used data and instructions. If 2.5MB of cache sounds good, then temper that with the painful street price of about $1,000 per chip. It's painful even when you keep in mind the fact that Intel sells virtually the same chip (in the form of the Xeon) to guys in business suits for use in corporate servers for about four times that price. The P4EE is now offered at speeds up to 3.4GHz.

The emergence of the P4EE took many by surprise, since it was introduced shortly after Intel launched an improved version of the standard Pentium 4 (non-extreme, in other words). Code-named Prescott, the revamped P4 packs new instructions for better performance in gaming and multimedia, as well as improved Hyper-Threading (Intel's fancy way of saying "virtual dual processors.") There's also 1MB of cache, vs. 512KB of cache in the older Pentium 4, and it's more efficient at processing long instructions. Unfortunately, software must be specifically coded to take advantage of the features in the "new" Prescott Pentium 4, so we don't expect it to shine until it's up near the 5GHz range.

Q What is currently AMD's finest?

In the AMD camp, the company continues to turn heads with the catchy phrase "64-bit computing," referring to its new 64-bit CPUs. And in 2004, you can expect all of AMD's top-of-the-line and mid-range CPUs to contain 64-bit capabilities. What's the big deal with 64-bit computing? Well, there are two advantages to 64-bit computing: The first is it supports craploads of RAM. If you want 8GB, you can have it with the Athlon 64 series. The second is 64-bit data types. By processing data 64 bits at a time, you can essentially double the amount of processing power of a 32-bit processor. The only problem is that software, including Windows XP, has to be coded to take advantage of the 64-bit CPUs, and we don't expect to see a lot of movement on this front until late 2004, when 64-bit CPUs are a bit more common.

Fortunately, the Athlon 64 is still freakishly fast in 32-bit code. Most of this is due to its large 1MB L2 cache and integrated memory controller. The memory controller in most traditional PCs (such as the Athlon XP and Pentium 4) is handled by a separate chip called the north bridge. The North bridge chips and memory controllers run at far lower speeds than the CPU core. By attaching the northbridge chip directly to the CPU core, AMD is able to run its memory controller at the core speed, meaning that, with the 2.2GHz Athlon 64 FX-51, you have a 2.2GHz memory controller. That gives the chip splendid memory latency and incredible bandwidth.



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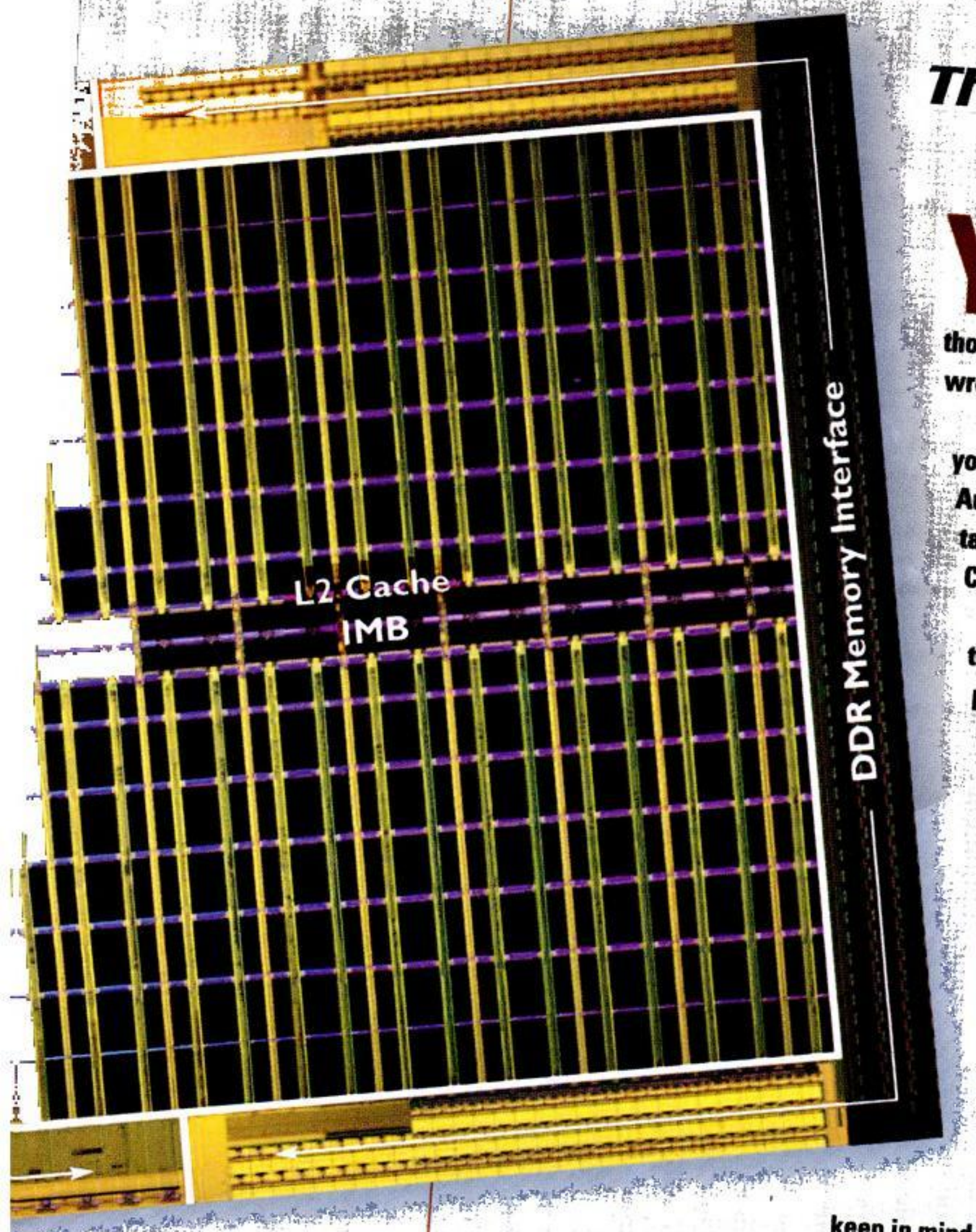
CPUs & COOLING



A CPU up close looks a lot like the floorplan for your average one bedroom apartment.

The need for speed still lives

You may have heard that nobody will ever need more power than a 60MHz processor. Yeah right. Those same PC-power naysayers said the same thing at 500MHz, 1GHz, and 3GHz. As always, those negative nabobs were flat-out wrong then, and they're flat-out wrong now.

The primary spec of a CPU is pretty basic: Clock speed. If it takes you overnight to render a home movie for a DVD you're authoring for Aunt Fannie, or if batch conversions of pictures from your new digital camera take longer than brewing a pot of coffee, then a faster CPU will be just about the most valuable upgrade you can make.

Trying to decode the megahertz madness isn't an easy job, though. Even though clock speed still matters, today it's entirely possible that in some applications and games, a 1,000MHz slower CPU can be faster. To wit, despite its 1GHz clock speed disadvantage when compared head-to-head with Intel's finest, AMD's Athlon 64 FX series is generally recognized as the better CPU for gaming. That doesn't make the Pentium 4 a wimp, though, because in just about any MP3 encoding apps, the P4 still rules the roost.

To discover the fastest processor for your needs, just think about what you do with your PC. Does your boat float on scientific applications that are floating-point intensive? Then look to AMD. Do you edit video with the latest version of Adobe *Premiere*, or are you a *Photoshop* fiend? Then the Pentium 4 is your elixir of choice.

Before you drop some ducats on a new processor, also keep in mind that sweeping changes are about to overtake the PC landscape. What changes? Follow along as we walk you through what's going to happen in the next 12 months in the land of the CPU.

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CPUs & COOLING Tech Terms

All the specs and tech lingo explained

BGA
Ball Grid Array. This is a method of packaging a chip in which the chip is attached to the printed circuit board by means of solder balls instead of pins or leads. This method of attachment offers better electrical contact than using leads or pins.

Branch Prediction
A method of improving CPU performance by predicting the results of likely computations and speculatively executing subsequent code. With branch prediction, the CPU tries to guess which direction the program is heading next and executes code based on that guess. If the CPU guesses right, it saves time by not having to wait for the computational result before proceeding. If it guesses wrong, it pays a price in wasted work and clock cycles.

Clock Speed
The frequency at which a CPU executes instructions. Clock speed is usually expressed in megahertz (MHz) or gigahertz (GHz).

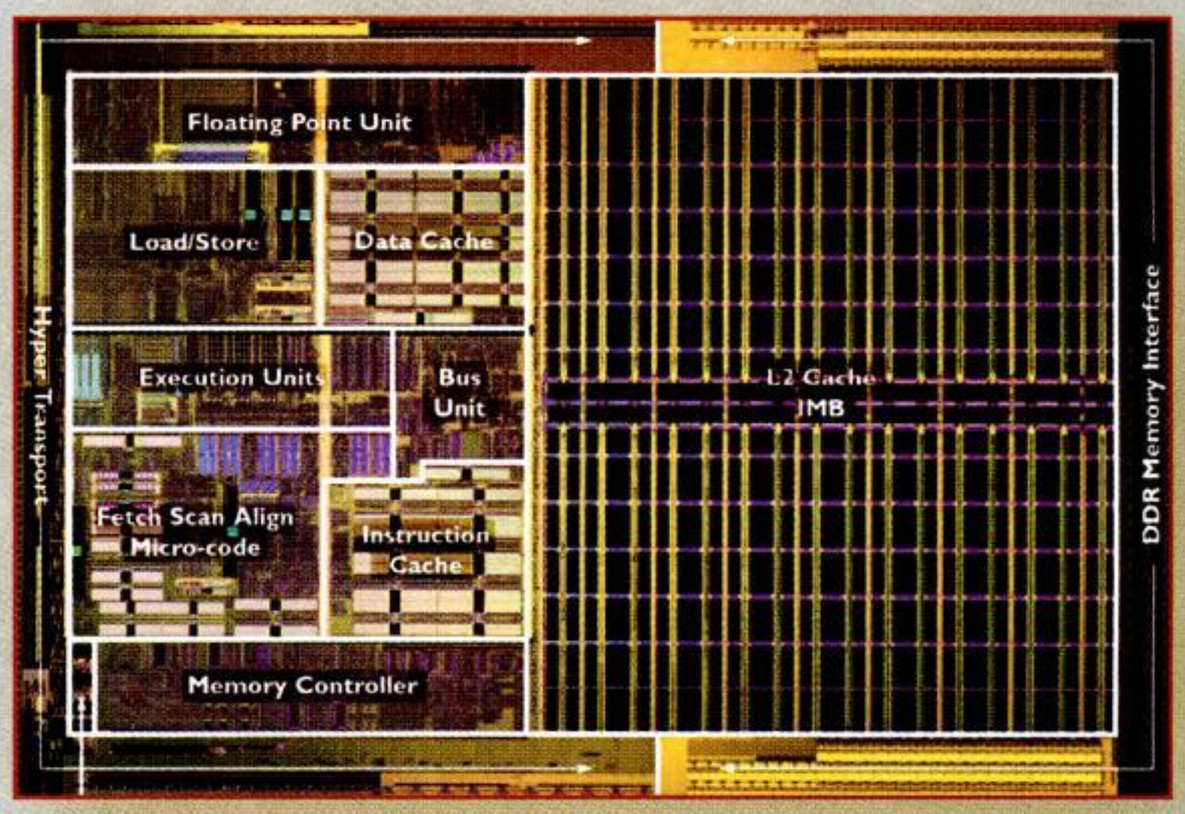
Floating Point Instruction
Instructions that involve data with decimal points. For example, 3.266 is a floating point number. The "point" is the decimal, which "floats" by changing places as the numbers being computed change.

Front-Side Bus Speed
The speed of the connection between the CPU and the main memory (RAM) on the motherboard. Front-side bus is frequently abbreviated into its acronym, "FSB," and is usually expressed in MHz.

Gates
Transistors in a CPU are also known gates because they are essentially switches that open and close to control the flow of signals to the processor.

Hyper-Threading
An Intel technology that permits the CPU to execute two program threads in parallel, as if it were two separate CPUs. A Hyper-Threaded CPU shows up as two separate processors in the operating system.

L2 Cache
Like all CPU caches, Level 2 cache (aka L2) functions as memory that stores frequently used data and instructions. When the CPU can't find the data or instructions it requires in L1 cache, it turns to the slightly slower--but considerably larger--L2 cache for answers.



L2 cache is where a CPU stores information for fast retrieval. Building it into the CPU reduces latency (the time the CPU has to wait for instructions) and improves performance.

Integer Instruction
Instructions that involve calculating whole numbers. For example, the numbers 0, 1 and2 are integers.

L1 Cache
A tiny amount of extremely fast memory used for storing instructions and/or data. L1 cache is built into the CPU itself, and information on it is immediately available to the CPU with practically no delay.

L3 Cache
After the CPU looks for information in the L1 and L2 caches, it turns to the L3 cache. In comparison to the L1 and L2 caches, it takes more time to get to information on the L3 cache. Nonetheless, the L3 cache is dramatically faster than main memory. Not many CPUs include an L3 cache, but Intel's Itanium processors and some of its Xeon CPUs stand out as notable exceptions.

Micron
A metric unit equaling one millionth of a meter. One micron is about 100 times thinner than a human hair. Modern processors like the Pentium 4 and Athlon 64 feature wire traces that are 0.13 microns thick!

Multiplier
A function built into a CPU that, when combined with a system's front-side bus speed (FSB), determines the CPU's speed. For example, a 100MHz front-side bus coupled with a multiplier of 8x produces a CPU that runs at 800MHz.

Pipelines
In modern CPUs, instructions are broken down into several parts to allow for more efficient processing, and these parts are executed in a CPU's pipelines. The number of pipelines a CPU has determines how many steps an instruction can be broken down into. For example, a Pentium 4 has a 20-stage pipeline.

Register
A special, high-speed storage area within a CPU. Data must be placed in a register before it can be processed. CPUs are sometimes categorized by the size of their registers; a 32-bit CPU has registers that are 32 bits wide.

SSE2
Streaming Single-instruction-multiple-data Extension 2. These are special instructions built into a processor that

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correspond with "hooks" built into software to allow for more efficient processing of multimedia tasks. Software has to be coded to take advantage of these features, and SSE2 is one example of this.

Transistors Count
The number of microscopic transistors that make up the CPU chip. Modern CPUs typically contain tens of millions of transistors. For example, a Pentium 4 is made up of 55 million transistors, while an Athlon 64 packs 106 million.

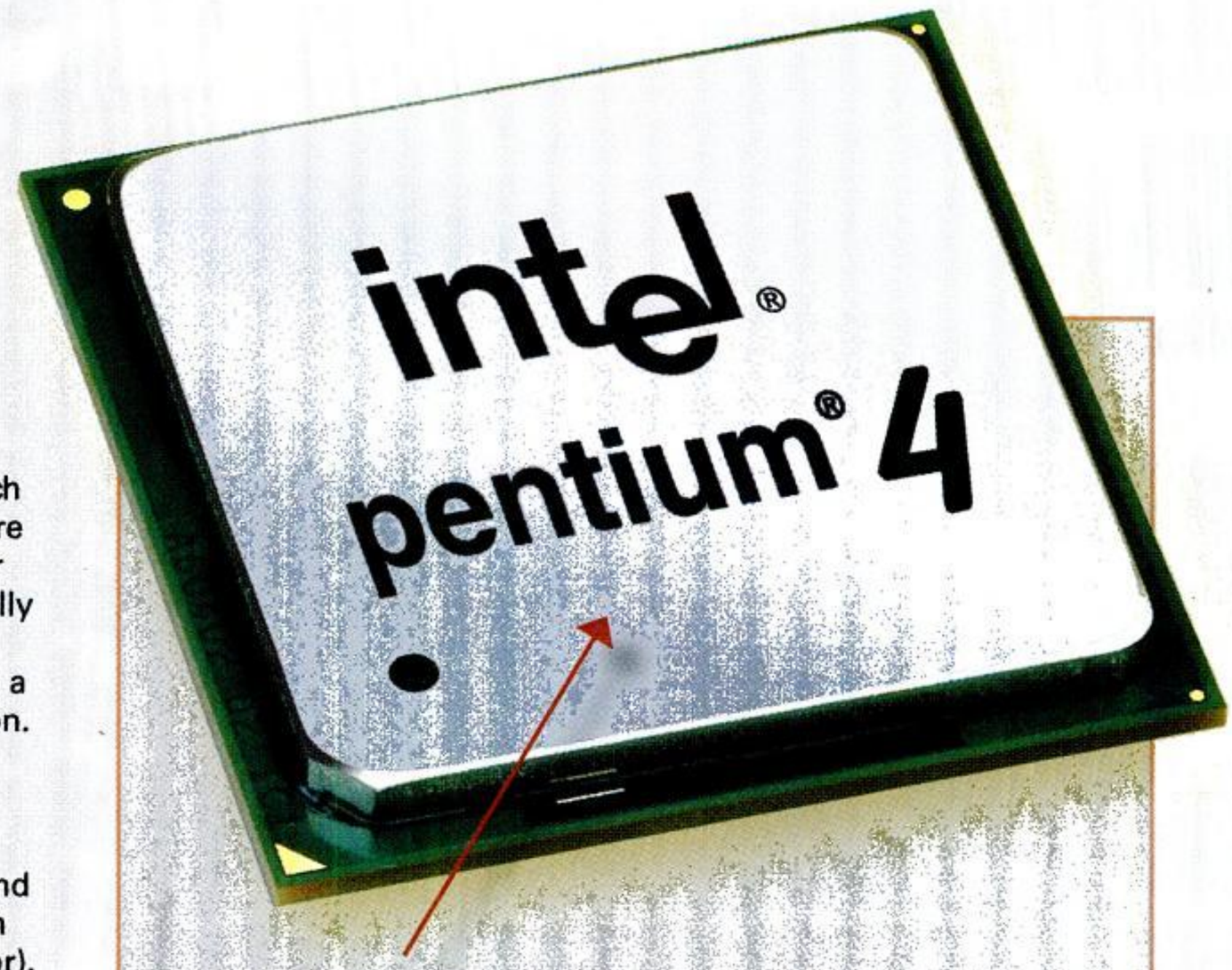
Cooling Terms:

Active Cooling
An arrangement in which a fan is used to ensure a steady flow of air over the heatsink.

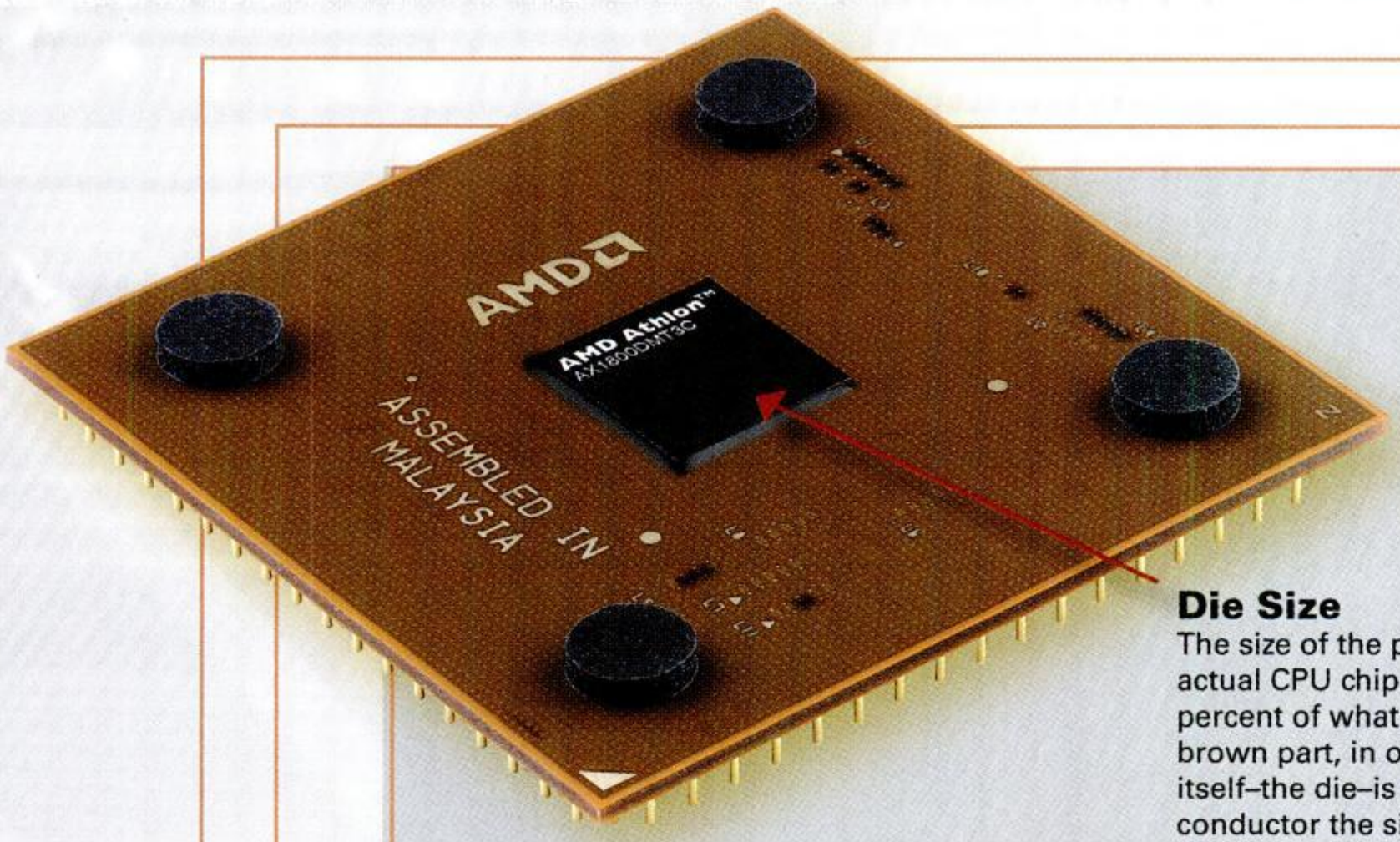
HSF
Heatsink and Fan. Most processors require a heatsink and fan to keep temperatures low and maintain reliable operation.

Passive cooling
An arrangement in which nothing is used to ensure a steady flow of air over the heatsink. This typically means that just a heatsink is used, rather than a heatsink/fan combination.

Phase Change
A process in which a coolant is evaporated and condensed (usually with the help of a compressor). Cooling systems that utilize phase change can reduce temperatures below the ambient room temperature. A refrigerator is a phase-change device.



Heat Spreader
A piece of metal–usually aluminum or copper–placed on top of a CPU die to improve transmission of heat away from it. Both the Pentium 4 and Athlon 64 feature heat spreaders.



Die Size
The size of the piece of silicon containing the actual CPU chip. If you look at a CPU chip, 90 percent of what you see is its packaging (the brown part, in other words). The actual "chip" itself–the die–is a rectangular piece of semiconductor the size of a human fingernail. This may or may not be obscured by a much larger piece of metal functioning as a heat spreader as seen above.

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CPUs & COOLING Cheat Sheet

You've got questions, we've got answers

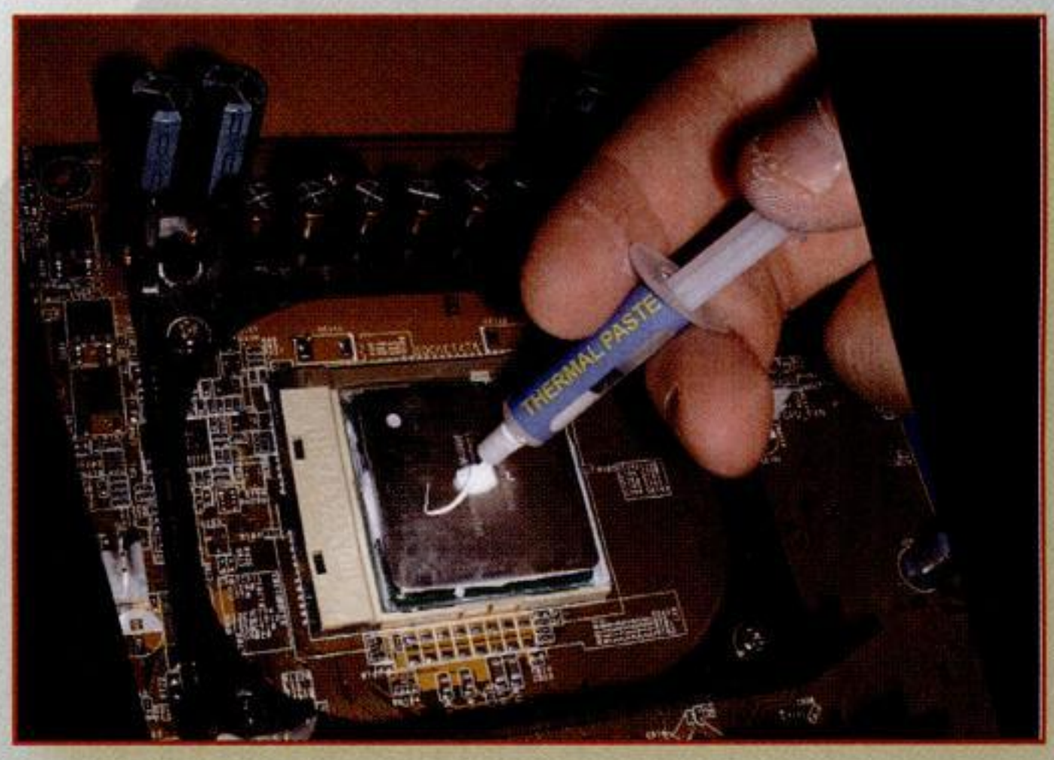
Intel's Pentium 4 Extreme Edition may be the fastest CPU in captivity, but the Athlon 64 FX 51 is just a bit slower and costs less than half the price.

Question: Which company, Intel or AMD, is selling the fastest CPU, and which company is selling the best-valued CPU?

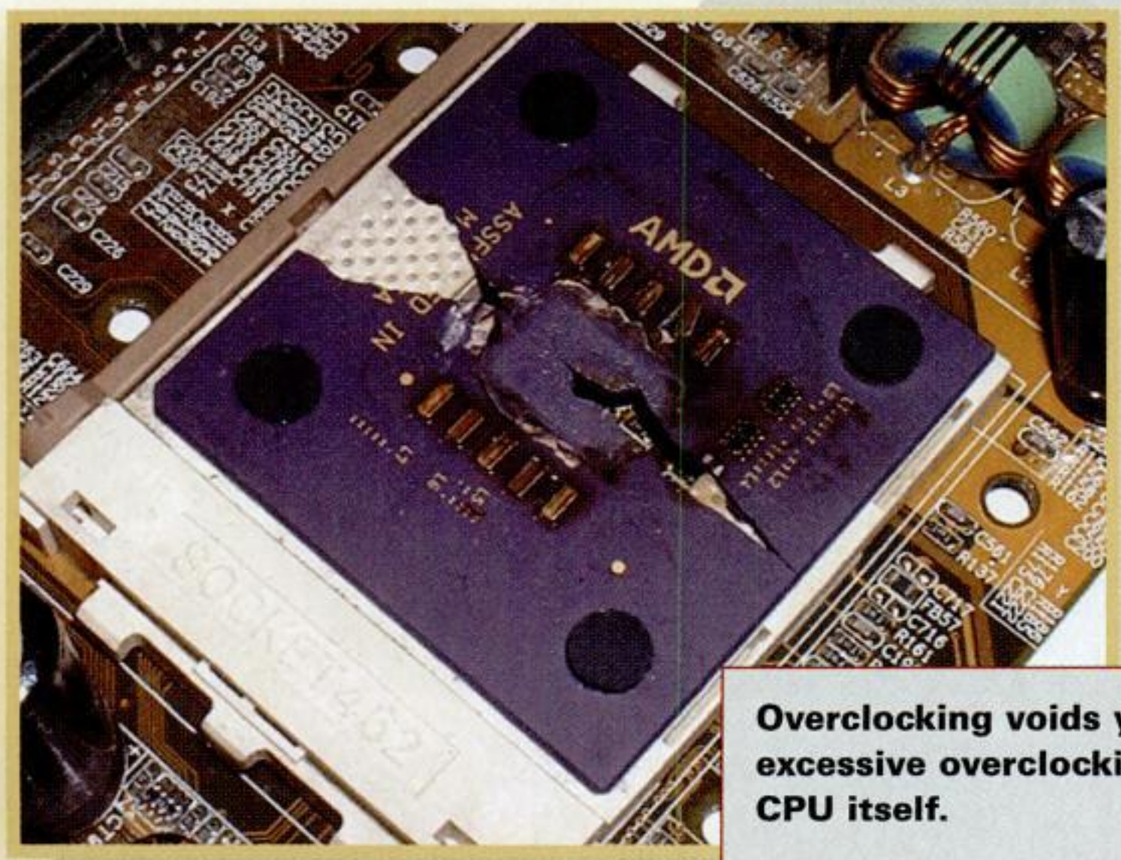
A: Sadly, this depends on how you define "fast." Today, having software that's properly coded for a CPU's architecture is almost as important as the CPU's clock speed. In general, the 3.2GHz Pentium 4 Extreme Edition is faster in most audio, video, and general applications than the 2.2GHz Athlon 64 FX-51. However, the Athlon 64 FX-51 is faster in gaming thanks to its on-die memory controller. Overall, the P4EE gets the nod for being speed king, while the Athlon 64 FX-51 gets it for pricing, since it's about $300 cheaper than the P4EE and runs faster in some apps and games than the P4 solution. AMD CPUs, in general, have always been less expensive than Intel's, and are a favorite of the "build it yourself" crowd, while the "money is no object" crowd usually favors Intel silicon.

Question: What is thermal paste and how do I properly apply it?

A:Thermal paste is the Cheez Whiz-like substance that you are supposed to spread between a heatsink and CPU to promote better heat transfer between them. The paste fills in the tiny gaps between the heatsink and CPU, and greatly increases the conductivity between the two. Failure to put paste on the CPU could lead to system major instability. The amount of paste to apply depends on what brand of paste you're using and whether you are putting it on a CPU with a heat spreader or on the core itself. If you're putting the paste on a heat spreader, you'll generally need just a bb-sized dollop of paste in the center of the heat spreader. On CPUs without heat spreaders, like the Athlon XP, you're not supposed to apply it directly to the core. Instead, put it on the heatsink, spread it out with a plastic bag, and then apply it to the CPU. Also, be careful not to apply too much paste, which is messy and will ooze out all over your CPU like a smashed PBJ sammich. Second, remember some thermal paste is conductive, and getting a bunch of it on your CPU or motherboard could lead to short circuits. Third, too much paste defeats the purpose. We recommend Artic Silver (http://www.arcticsilver.com/) because it works great and is affordable.



Applying thermal paste to the CPU greatly increases thermal conductivity and is a must for today's hot, hot, hot CPUs.



Overclocking voids your warranty, but excessive overclocking could void the CPU itself.

Question: How easy is it to damage a CPU during either overclocking or improper installation?

A: Most overclocking (running your CPU above its rated speed) hijinks usually don't permanently damage the CPU in the short term. However, excessive overclocking, especially with inadequate cooling, can greatly shorten the life of the processor. A stock CPU from Intel or AMD will usually give you many years of service before dying. However, an overclocked CPU could fail after several months, or after two or three years of overclocking. It's really a crap shoot. We've seen cases in which the CPUs simply stopped running at the overclocked speed after two years of service, but still ran fine at the stock speeds. Minor overclocking feats usually won't hurt much, though, and in cases where you're overclocking a lower-bin part (say, a 2.4GHz Pentium 4C) to higher speeds, you can probably get away with it for some time without any ill side effects.

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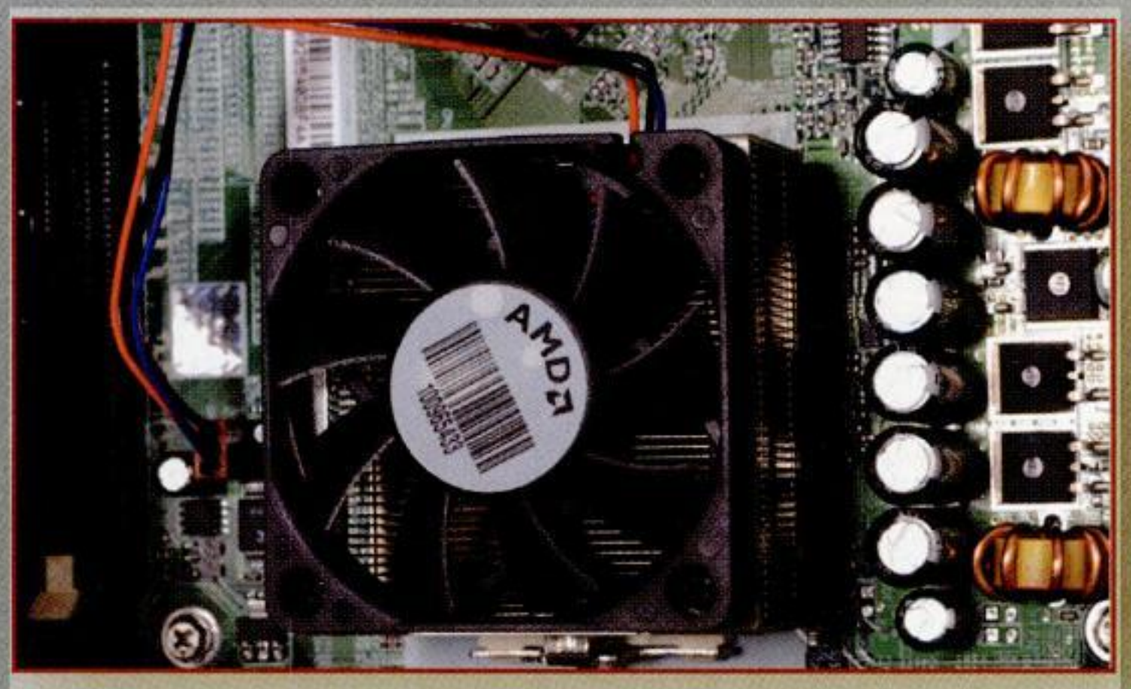
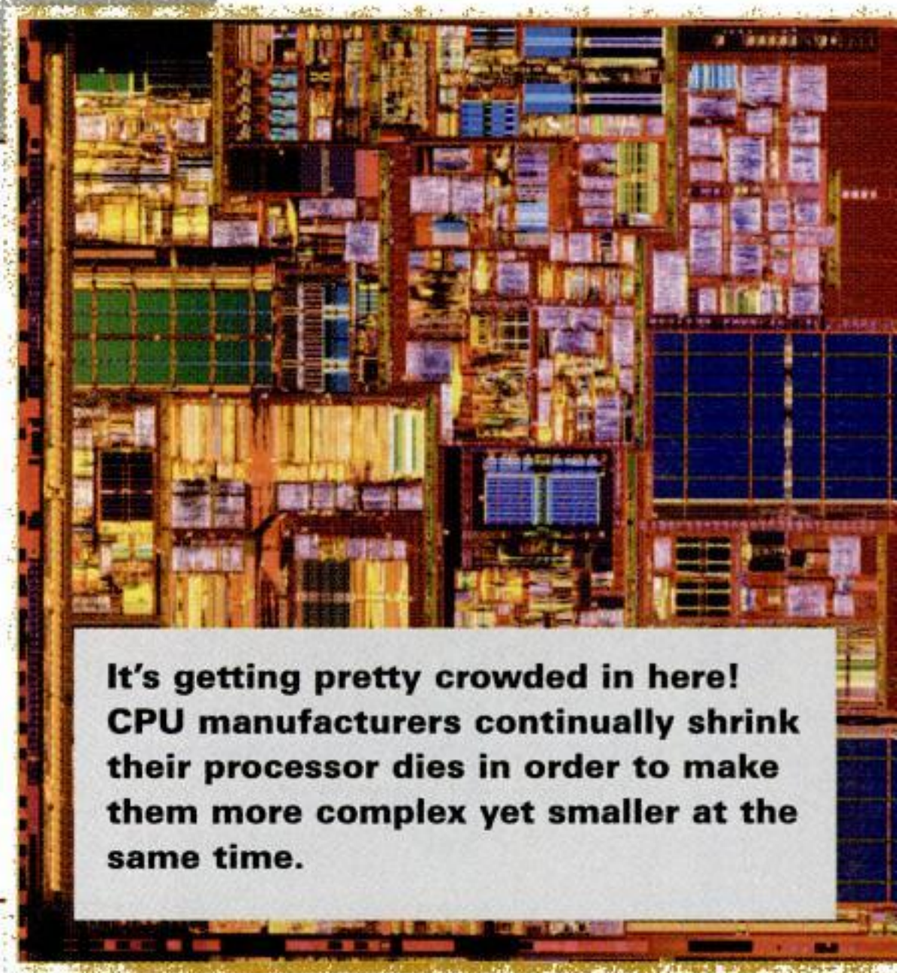


The Athlon 64 FX-51 will come into its own when applications actually support its 64-bit architecture.

Question: What are the real-world benefits of 64-bit computing, and will I be able to reap those benefits today, a few months from now, or a few years from now?

A: Does 64-bit computing really matter yet? Not today. To take advantage of the 64-bitness in the Athlon 64 series, you'll need an operating system that supports 64-bit data transfers. Right now, 64-bit support for Windows XP isn't planned until at least summer of 2004, but there are also rumors that it won't be a reality until fall or even winter! When it does come out, though, you will be able to reap the benefits. The first will be large memory support. If your motherboard supports 16GB of RAM, you'll be able to run it. The second is 64-bit application support. Anything that takes two passes at 32-bit should take only one pass at 64-bit.

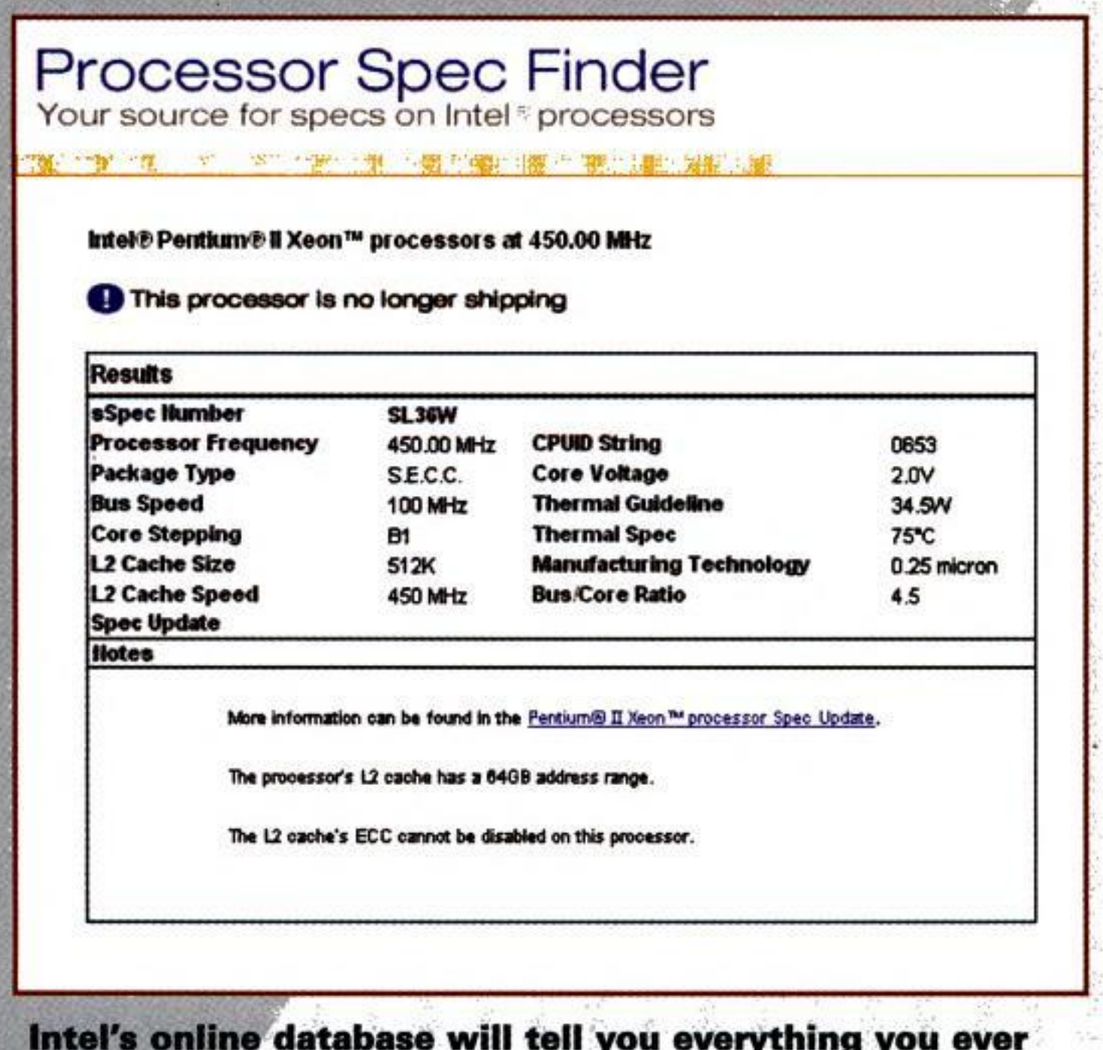


It's getting pretty crowded in here! CPU manufacturers continually shrink their processor dies in order to make them more complex yet smaller at the same time.

Question: What upcoming technologies will allow us to keep pace with Moore's Law, and guarantee that circuit paths will continue to shrink?

A: Moore's Law, which says transistors on a chip would double every 24 months, will likely continue for many more years. One area that's expected to go through a change within the next few years is the technology used to draw the circuits. Today, trying to draw the circuits used to make 90-nm CPUs is like trying to write calligraphy with a paint roller. By 2007, we should have the first chips (including CPU, GPU, and RAM) using Extreme Ultraviolet lithography or EUV. EUV is expected to be useable on chips down to at least 30 nanometers.

This year, we should see the first PC CPU to use strained silicon. Intel literally stretches the silicon in its chips to reorient the atoms in a manner that allows for the faster flow of electricity. As a practical matter, many believe Moore's Law will see an end by the year 2020, when we're pushing 16-nm chips.



Processor Spec Finder

Your source for specs on Intel® processors

Intel® Pentium® II Xeon™ processors at 450.00 MHz

This processor is no longer shipping

Results			
sSpec Number	SL36W		
Processor Frequency	450.00 MHz	CPUID String	0653
Package Type	S.E.C.C.	Core Voltage	2.0V
Bus Speed	100 MHz	Thermal Guideline	34.5W
Core Stepping	B1	Thermal Spec	75°C
L2 Cache Size	512K	Manufacturing Technology	0.25 micron
L2 Cache Speed	450 MHz	Bus/Core Ratio	4.5
Spec Update			

Notes

More information can be found in the Pentium® II Xeon™ processor Spec Update.

The processor's L2 cache has a 64GB address range.

The L2 cache's ECC cannot be disabled on this processor.

Intel's online database will tell you everything you ever wanted to know, and then some, about your CPU.

Question: How can I determine the exact voltages and temperature thresholds of my CPU?

A: This takes a little bit of work. First, open up your PC, remove your heatsink, clean off the thermal paste, and look for the S Spec on the heat spreader (or, even esier, look at the box your CPU came in). On a 3.2GHz Pentium 4 Extreme Edition, for example, the S-spec is SL7AA. Assuming you have another computer that works nearby, point your browser to http://processorfinder.intel.com/. Once there, you can punch in your S-spec and Intel will tell you the core stepping, thermal spec (64 degrees Celsius), and voltage (maximum of 1.550 volts). On the new Prescott Pentium 4, Intel has taken CPU temperatures to a new level. Each processor will be able to tell the computer what its maximum temperature threshold is.

On Athlon XP CPUs, you also need to remove the heatsink to find the processor's "ordering part number" or OPN. On an Athlon XP 3200+, for example, it's AXDA3200DKV4E. The AX means the chip is an Athlon XP. The DA means it's a 0.13-micron part, the D indicates it uses an organic PGA package, the K tells you its operating voltage of 1.65 volts, the V is maximum die temperature (85 degrees Celsius), the 4 is the amount of cache (512KB), and the E tells you it is a 400MHz bus processor. If you want to check out your Athlon XP, visit: http://www.amd.com/gb-uk/assets/content_type/DownloadableAssets/Processor_Recognition_Rev05_ENG.pdf.

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ADDING AN AFTERMARKET Fan TO YOUR Pentium 4

1. Choosing a Fan:

Any retail CPU package will include a stock heatsink that has been approved for use by the CPU's manufacturer, but the upgrader in you may desire more cooling, less noise, or both. A high-speed fan will provide better cooling for your P4, but may sound like an airplane taxiing down the runway. Meanwhile, a fan with multiple speed settings will allow you to strike a balance between cooling and noise. Most fans have a noise-level specification printed on the box—anything around 32 decibels or lower should be tolerable.

Fan speed aside, there are two characteristics you should look for in a CPU cooler: First, you'll want either an all-copper heatsink or an aluminum heatsink with a copper base; all-aluminum heatsinks don't transfer enough heat to meet the demands of today's fastest processors, but copper does a terrific job. Second, the larger the diameter of your CPU fan, the more air it will move at a given rotational speed.

2. Installing the Fan

The heatsink/fan isn't the only part of the CPU cooling equation—the thermal compound you apply between the processor and the heatsink is just as important. At Maximum PC, we prefer Arctic Silver 5 (www.arcticsilver.com). Carefully clean off any residual thermal compound from both your CPU and heatsink using rubbing alcohol before applying a new layer or Arctic Silver.

Pentium 4 heatsink/fan contraptions reside within a plastic frame with four posts. Each post clips into a bracket surrounding the CPU socket on the motherboard.

To install a new P4 heatsink/fan, you'll need to follow the instructions in the box, since installation procedures may vary. (Most Pentium 4 coolers will somehow lock on to the plastic frame surrounding the CPU socket.) Once your new cooler is mounted, don't forget to plug the fan into the power header on your motherboard!

We recommend monitoring your CPU temperatures for a little while after installing a new heatsink/fan, especially if you're overclocking. You can do this in the BIOS (usually on the Health screen), or from within Windows using a free utility like Motherboard Monitor (included on the CD). In general, a Pentium 4 processor should not exceed 115 degrees Fahrenheit under a heavy workload.

3. The Awesome Blossom

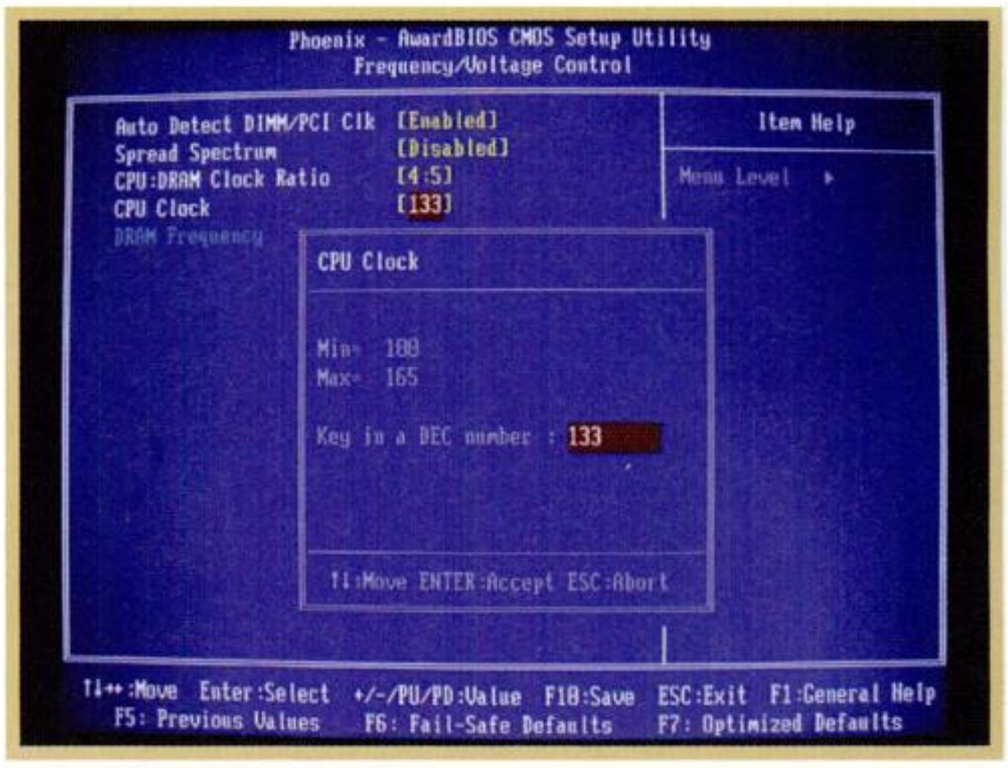
Our top pick for a Pentium 4 cooler is the Zalman CNPS7000A-Cu (www.zalman.co.kr). This flower-like heatsink/fan offers two speed settings ("silent" and "normal"), both of which are pretty quiet. And at the "normal" setting, the CNPS7000A-Cu delivers enough cooling power for moderate overclocking.

This Zalman fan/heatsink moves a lot of air, and is one of the best CPU cooling solutions on the market.

4. Megahertz for Nuthin'

Overclocking is the dark art of running a chip above its rated speed. Sometimes it works, sometimes it doesn't—and it could potentially damage your hardware, so don't try overclocking unless you're comfortable with the risks. However, careful overclocking can often yield extra performance for little or no extra money.

Your CPU's speed is determined by multiplying the speed of your front-side bus (FSB) with the processor's multiplier ratio. For example, an 100MHz FSB times a multiplier of sixteen equals a 1.6GHz processor (100 x 16 = 1600). Make sense? You can usually overclock a CPU by changing either the FSB speed or the multiplier ratio (or both). Unfortunately, all Pentium 4 processors ship with their multipliers locked, leaving the FSB as the only overclocking option. Most motherboards allow you to change the FSB speed from within the BIOS (this option is usually located on the Frequency/Voltage Control menu). We recommend increasing the FSB speed a few megahertz at a time (for instance, going from 200MHz to 203Mhz) and monitoring CPU temperature and system stability after each bump up. A word of warning: Unless your mobo supports independent FSB, memory, AGP, and PCI clock speeds, overclocking the FSB will overclock the latter three as well, potentially causing reliability problems.



These days, overclocking is usually done by adjusting the FSB speeds in our system's BIOS.

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ADDING AN AFTERMARKET Fan TO YOUR Athlon CPU

1. Choosing a Fan:

Picking a heatsink/fan for your CPU inevitably involves a tradeoff between noise and cooling performance. You can either have massive cooling with a lot of noise or less cooling and quieter operation. If noise pollution is a concern, look for a fan that generates 32 decibels of noise or less (most manufacturers provide a decibel rating on a fan's retail box).

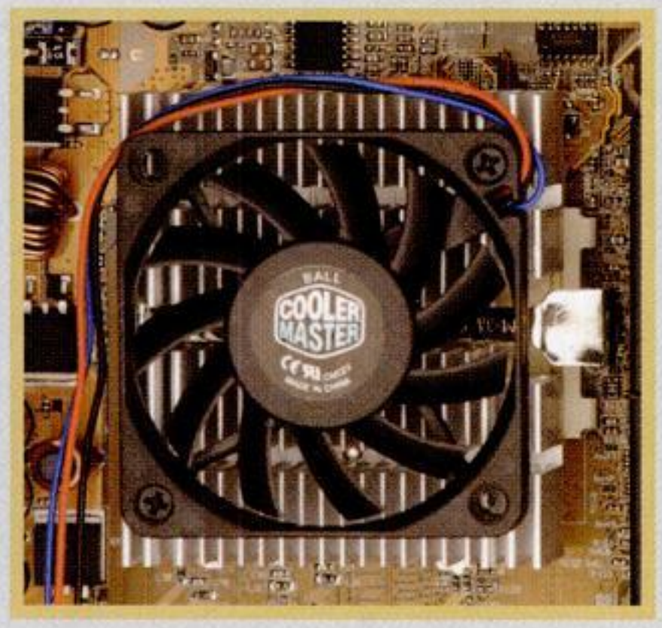
There are two features you should look for in any Athlon cooler: First of all, a big fan will offer better cooling than a small one without spinning as fast. However, some Athlon motherboards have capacitors positioned very close to the CPU socket, preventing the installation of large coolers. Second, choose a heatsink that features a copper base or an all-copper design, as these are better at wicking away heat than all-aluminum heatsinks.

Our recommendations? The Zalman CNPS7000A-Cu (www.zalman.co.kr) is an excellent heatsink/fan that's compatible with both the Athlon and the Athlon 64 and can be set to either "silent" or "normal" modes. Meanwhile, the Thermaltake A4002D (www.thermaltake.com) is an inexpensive cooler that utilizes new Tip-Magnetic driving fan technology that funnels air directly to the heat source for better performance with less noise.

2. Installing the Fan

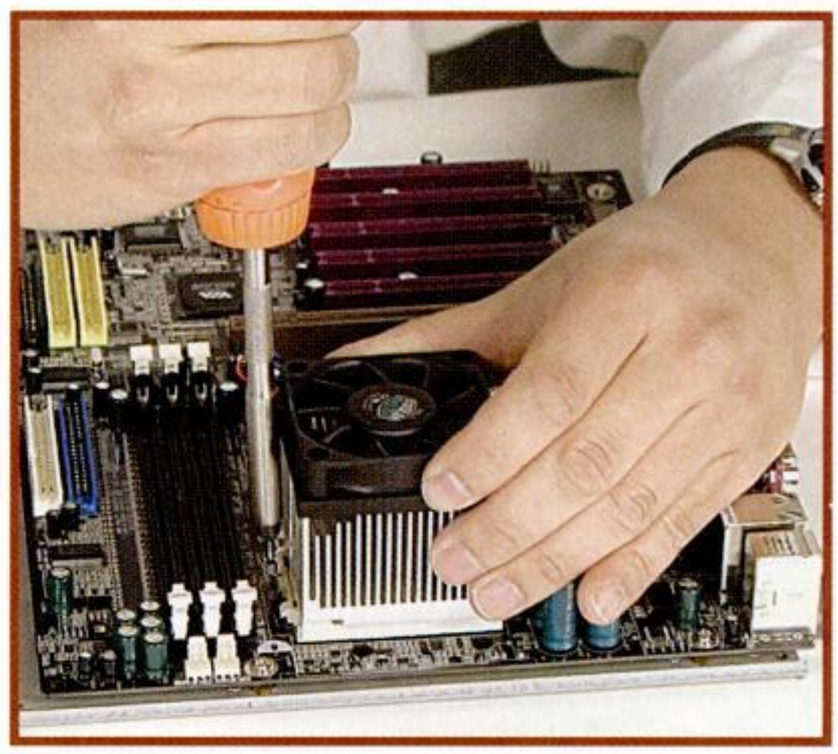
The thermal compound between your cooler and the surface of your CPU is just as important as the cooler itself. Here at *Maximum PC*, we've used Arctic Silver (www.arcticsilver.com) for years, and it remains our favorite thermal compound. Before applying new thermal compound, don't forget to clean off any leftover compound from both your CPU and heatsink using rubbing alcohol.

Installing an Athlon heatsink/fan for the first time can be tricky. Apply a small amount of thermal compound to the heatsink and then place the heatsink directly on top of the die. Clip one side of the heatsink to the CPU socket, then grab a flat-head screwdriver and push the other clip down and slightly outward, hooking it onto the CPU socket. Be very careful not to push too hard, or you might inadvertently crush your processor's delicate core! Finally, don't forget to plug the fan into your motherboard's fan power connector.



The stock Athlon heatsink/fan will work just fine, but if you are overclocking you're going to need more juice.

Once your new cooler is installed, keep tabs on your CPU temperatures. You can do this through the Health screen of the BIOS on most mobos, or through Windows using a program such as Motherboard Monitor (mbm.livewiredev.com). In general, an Athlon shouldn't exceed 130 degrees Fahrenheit during heavy usage.



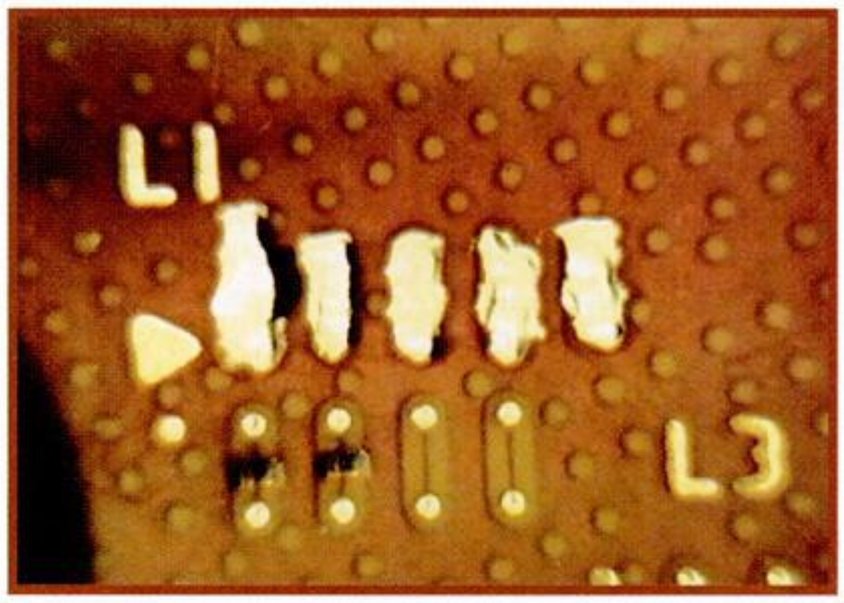
Be careful placing the heatsink on your Athlon XP CPU. Since they lack heatspreaders, their delicate cores are exposed and can be damaged easily.

3. Let's Overclock!

Overclocking—the practice of running a computer chip above its rated speed—is a dark art that could damage your system and will void your warranty. Sounds like fun, no? When it works, overclocking can squeeze extra performance out of an aging system for little or no money, and one thing's for sure: It's easier on an Athlon than on a Pentium 4.

Your CPU's clock speed is determined by multiplying the speed of the system's FSB. Overclocking can thus be accomplished by changing the FSB speed, the multiplier ratio, or both. Like P4s, Athlons are multiplier-locked at the factory—but unlike P4s, most Athlons can be unlocked. The unlocking process is beyond the scope of this article, but the best place to start is an unlocking kit from HighSpeed PC (www.highspeedpc.com).

Most mobos allow FSB speed tweaks in the Frequency/Voltage Control menu of the BIOS. We recommend upping the FSB a few megahertz at a time and monitoring CPU temperatures and testing for stability after each increase. Also, unless your mobo allows separate FSB, memory, AGP, and PCI clocks (few do), overclocking the FSB will overclock the other three too, potentially limiting your success.



These connected circuits of this Athlon XP CPU tells us it's "unlocked" and ready for overclocking!

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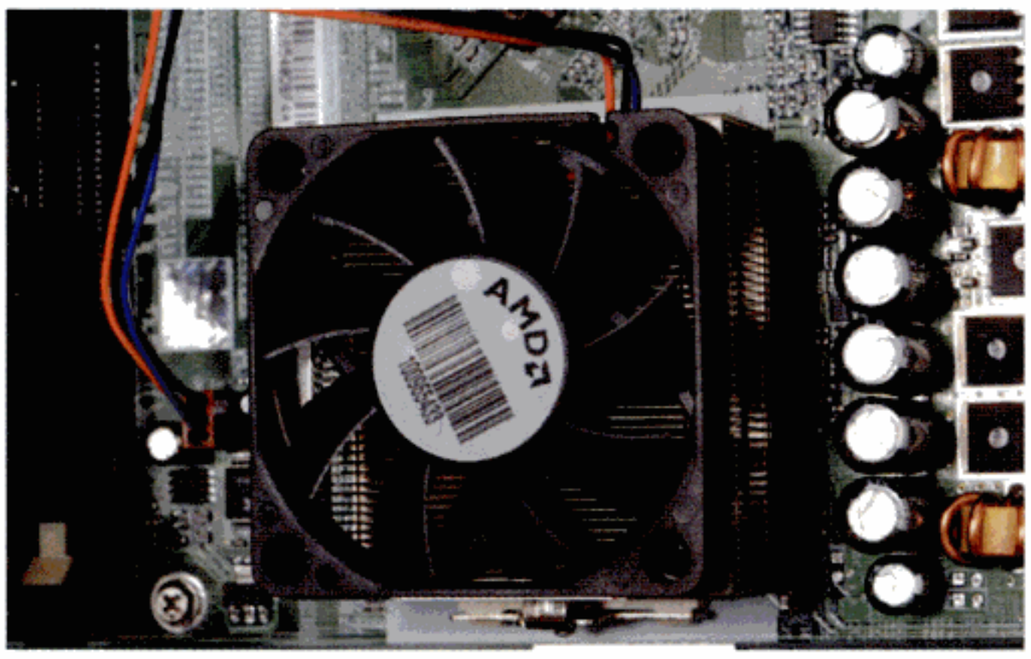
Ask the Doctor

Your PC is sick, we've got the cure

HOT OR NOT?

Is the heatsink/fan that came with my CPU sufficient or should I buy a better heatsink/fan?

The heatsink that came with your CPU is certified by the manufacturer of the CPU to offer sufficient cooling for running the CPU at its standard clock speed. If you plan on overclocking, however, it is wise to purchase an aftermarket cooling solution to handle the increased temperatures that overclocking produces.



Although you might think a bundled heatsink/fan with a CPU would be bunk, they actually work quite well.

MO' MEMORY

I was wondering how much of a performance boost the AMD XP CPUs get from running on a 166MHz FSB (333MHz) in conjunction with 333MHz DDR RAM? I've seen some websites that claim there's no significant performance gain. Is this because of the 64-bit CPU-to-memory data path that the Athlon XP uses?

The Athlon XP does experience a fair boost when its FSB is increased from 266MHz to 333MHz DDR. While clock speeds continue to climb at a crazy pace, memory bandwidth has not. The Athlon is handcuffed a bit by its narrower bus (the P4 has a 256-bit CPU-to-memory data path), but still benefits from the added bandwidth. In general, we recommend running your system's FSB and memory at the fastest speeds they'll tolerate.

CLOCK CONUNDRUM

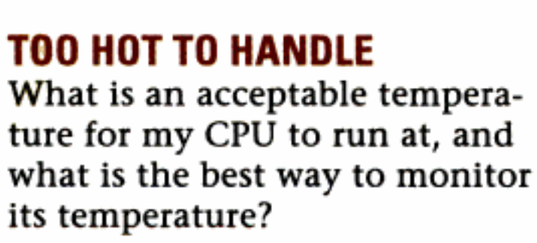
I recently noticed that my AMD 1.1GHz processor has changed speed. It has operated at 1.1GHz for over a year and a half, but now it's operating at 850MHz. I haven't fooled with anything in the case, and no one else has used my system. How did this happen?

Your system's CMOS likely was reset. We've seen systems occasionally "forget" their configurations, and it usually indicates a bad connection on the CMOS battery, static build-up, or a dying CMOS battery. (The CMOS battery is that coin-cell on your motherboard.) What you need to do is go into your BIOS and verify that the system bus is running at 133MHz. When the CMOS lost its contents, it probably defaulted to a 100MHz bus. The math backs this up: 8.5x100=850MHz; 8.5x133=1100MHz. The other possibility is that your system builder used a remarked Athlon. That is, he or she took an 850MHz Athlon, shorted the L1 bridges, and reset it to 1.1GHz. Over time, the material that's used to unlock the bridges can wear away, and the CPU can default to its stock 850MHz speed. The Doctor believes that your problem is more likely the first scenario than the second.

TOO HOT TO HANDLE

What is an acceptable temperature for my CPU to run at, and what is the best way to monitor its temperature?

In general, a Pentium 4 CPU should never go above 115 degrees Fahrenheit, and an Athlon should stay below 130 degrees. If either CPU is hovering above these levels, it would be wise to invest in a bigger, more efficient cooling mechanism for the CPU. The best way to check your CPU's temperature is to either look in your BIOS (there's usually a screen that displays the CPU temp and fan rotation speed, among other things.), or to use a program called Motherboard Monitor, which is on the disc that accompanies this magazine.

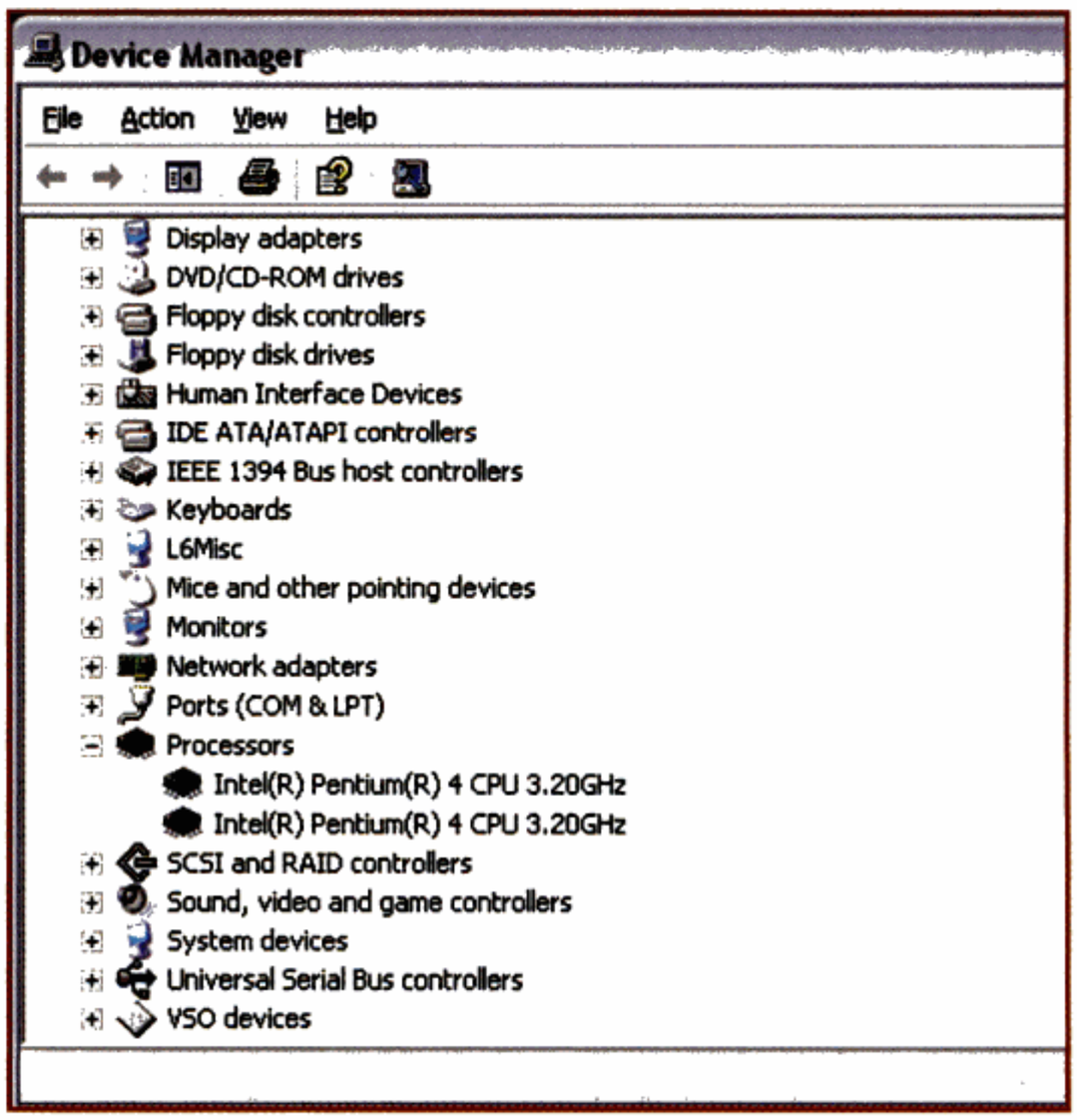


Motherboard Monitor

DOUBLE TROUBLE

I was told that if you have dual CPUs, you can dedicate certain processes to each CPU. I was wondering if this would work for Intel's Hyper-Threading (HT) technology. Can I set background processes to run on the virtual second CPU, and everything else to run on the primary CPU? Would this boost performance?

Yes. Having a dual-processor or HT-enabled machine indeed makes it possible to dedicate workloads for processes and applications via Windows XP's Task Manager to the two "virtual" CPUs. However, keep in mind that Hyper-Threading is not the same as two physical CPUs. The single CPU still has the resources of a single CPU, it's just a little more efficient at doling them out when in HT mode. If, for example, you run two applications that both require the same functions of the CPU, the performance will be no better, and may even be worse, if the applications are not optimized for Hyper-Threading. On the other hand, if you run multiple applications that use different functions of the CPU, you can see quite an efficiency boost. HT isn't the magic bullet of computing, but it does work very well at some things.■



An Intel Hyper Threading-enabled CPU appears as two physical processors to the OS, but isn't as efficient as actually having two procs.

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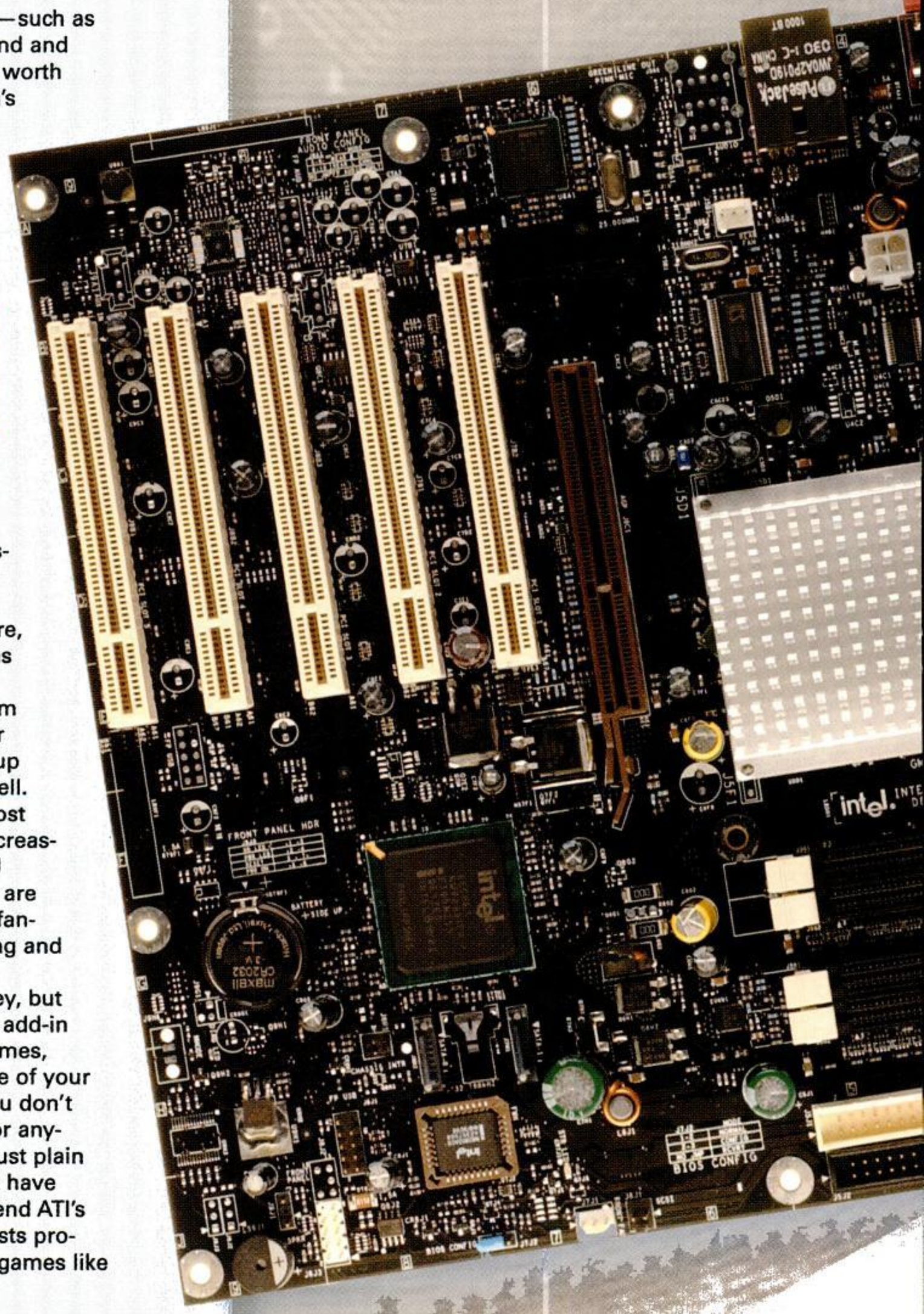
MOTH

Q What are the basic functions handled by my north bridge and south bridge chips?

The north bridge chip resides near the top of the motherboard, near the CPU socket, and serves as a four-way intersection connecting the CPU, memory, video card (AGP) bus, and its partner, the south bridge chip. This means the north bridge chip allows the CPU to retrive information from memory, lets the videocard send commands from the AGP bus to the CPU and also lets all those plugged-in peripherals like your modem or network card down in the lower half of the motherboard communicate with the CPU and memory via the south bridge chip.

Most of a motherboard's "value-added" features—such as the IDE controller, USB controller, and onboard sound and Ethernet—are handled by the south bridge chip. It's worth noting that some core-logic chipsets, such as nVidia's nForce3, integrate all their functionality into a single chip, thus doing away with the north bridge/south bridge construct. Also, AMD's new Athlon 64 CPUs have integrated the memory controller diretly into the CPU, alleviating those duties from the north bridge chip.



Q What are the pros and cons of onboard sound, video, RAID, and Ethernet support?

Back in the day (2001), motherboards included nothing but the basics—a PS2 port, serial, parallel and maybe, if you were lucky, a USB port. Nowadays though, motherboards include every possible add-in feature you could ask for: Networking, sound, video, RAID (a technology for letting several hard drives work together as a single drive), FireWire, multiple USB ports, and more. In some case, such as with onboard RAID and Ethernet, you get the same level of functionality and performance you'd get from an add-in card. Having these features built into your motherboard is usually a good thing, since it frees up the PCI slots and could save you some money as well.

Integrated sound is a mixed bag though, with most chipsets offering poor-quality built-in sound that decreases overall performance by consuming valuable CPU cycles for audio processing. The notable exceptions are nVidia's nForce and nForce2 chipsets, which sound fantastic and even offer real-time Dolby Digital encoding and decoding capability!

Finally, onboard video may save you some money, but you'll pay a massive price in performance. For one, add-in cards have their own onboard memory to use in games, but integrated graphics chips usually just steal some of your system memory. Sure, they say it's "shared" but you don't want to share your precious memory with anyone or anything, trust us. More importantly, integrated video just plain sucks for today's demanding 3D games. If you must have integrated graphics, we can half-heartedly recommend ATI's Radeon 9100 IGP since it's the only chipset that boasts programmable shaders demanded by next-generation games like *Half-Life 2* and *Doom 3*.

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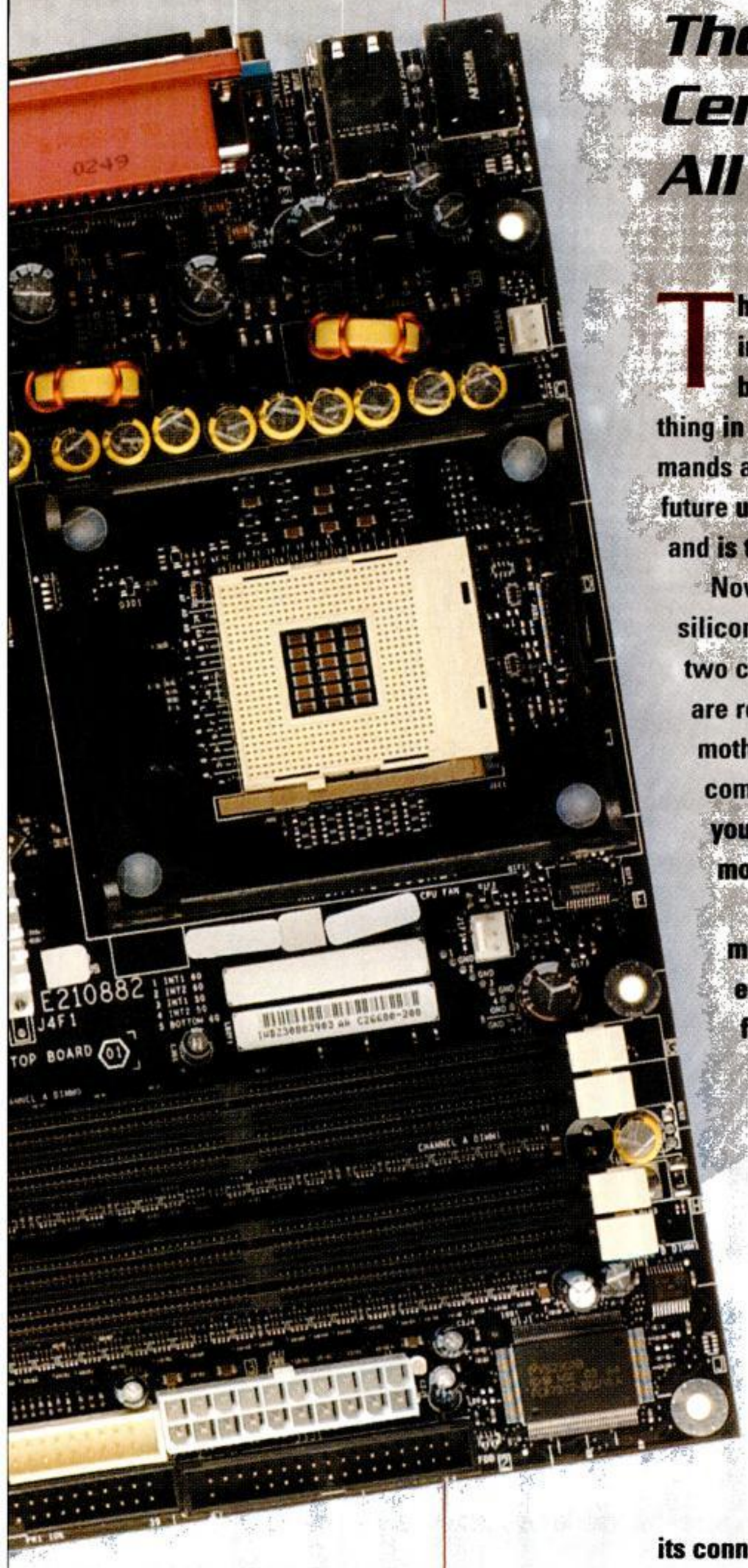
HERBOARDS



Intel sells its motherboard chipsets to other vendors, but also makes Intel-branded boards as well, such as this 875P model.

The motherboard is the Grand Central Station of your PC. All aboard!

The biggest mistake a budding PC enthusiast can make is to underestimate the importance of a well-designed, properly-configured motherboard. A PC's motherboard is the technological equivalent of Grand Central Station—virtually everything in the computer connects to it, and in order for your PC to "do" anything the commands always have to be routed through the motherboard. A motherboard determines all future upgrading options, limits how much performance you'll ever extract from your rig, and is the number one factor in your system's overall level of stability.

Now, upon close examination of a motherboard you will note two distinct pieces of silicon. One is near the top of the motherboard and the other is near the bottom. These two chips are what is called the "core-logic chipset," and they are the ones who are really running the show. One of these chips controls things on the top-half of the motherboard, while the other handles the talking on the bottom-half. Together they comprise all the features, doodads and doohickeys that are "onboard," meaning stuff you won't have to buy because it's already on the motherboard such as a LAN port, modem, audio and so forth.

Oh, but it doesn't end there! If you're in the market for a new motherboard, you must also worry about what new technologies are looming on the horizon, threatening to make your shiny new purchase obsolete before you can even get home from the store. And right now is both the worst time and the best time in years to invest in a new mobo! It's the worst time because in the next few months we'll see the emergence of an entirely new memory technology (DDR2), peripheral bus (PCI Express), and motherboard formfactor (BTX), as well as new CPUs from both AMD and Intel that may not be compatible with all current mobos. These new technologies will make everything on the market currently "yesterday's news" overnight. The good news, however, is that once this newfangled hardware arrives today's top-of-the-line hardware will suddenly become extremely affordable. Can you say, "fire sale?" We knew you could.

If you're considering building your first PC or are simply looking to understand more about the specie Personalus Computerus, the motherboard is an excellent place to begin. Since every single component plugs into the motherboard or plugs into something attached to the motherboard, understandings its connections and how it works with other components will give you a good overview of how a PC works.

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MOTHERBOARD Tech Terms

All the specs and tech lingo explained

AGP Slot
Accelerated Graphics Port. AGP is a graphics card interface developed by Intel which provides the graphics controller direct access to the PC's main memory. The AGP interface has been improved over the years and is now denoted as 2x, 4x and 8x AGP. 8x AGP indicates that the interface provides a theoretical bandwidth eight times higher than that of the original AGP standard.

ATA
Advanced Technology Attachment. This is the parallel interface used to attach hard drives, CD ROMs, DVD drives, etc to the majority of PCs on the market. This term is used interchangeably with IDE.

BIOS
Basic Input-Output System. The BIOS is the first program the computer executes when it is turned on and is typically contained in a ROM chip on the motherboard. It allows the computer to perform rudimentary self-diagnostics and allows access to the hard drive so that the Operating System can load.

DDR memory
Double Data Rate Memory. Memory which transfers data on both the rising and falling edge of the clock and therefore is capable of transfering twice the amount of data for any given clock speed. DDR memory is the most common type of memory used in PCs today.

DIMM
Dual Inline Memory Module. The most commonly used memory modules today are DIMMs. These have electrical contacts arranged in two long lines on both sides of the module's bottom edge. Most conventional SDRAM DIMMs have 164 pins, whereas DDR DIMMs have 184 pins.

Dual Channel
Dual Channel memory interface. An arrangement where the memory controller has two separate pathways by which it can access main memory, giving potentially twice the bandwidth. For the dual channel interface to function, memory modules must be installed in pairs that are identical in both capacity and speed.

Fan Headers
The connectors on the motherboard onto which the CPU, power supply and system cooling fans can be attached. Some fan headers are capable of controlling the speed of the fan connected to it based on temperature readings taken by sensors on the motherboard.

Form Factor
The specification for the physical size and layout of the motherboard. Form factors permit the standardization of motherboards so that they will fit in a wide variety of enclosures. The most commonly encountered form factors today are ATX, Micro-ATX and Flex-ATX.

Frequency clock
The quartz timing device that provides precise electric pulses that drive and synchronize everything in the computer.

Front Side Bus
The connection between the CPU and the main memory (RAM) on the motherboard.

IDE Port
Integrated Drive Electronics port. For all practical purposes, IDE is ATA. While IDE refers to the interface architecture and ATA is the actual specification, the difference is lost to most users. IDE port and ATA port refer to the same 40-pin connector on the motherboard. ATA drives are also commonly called IDE drives.

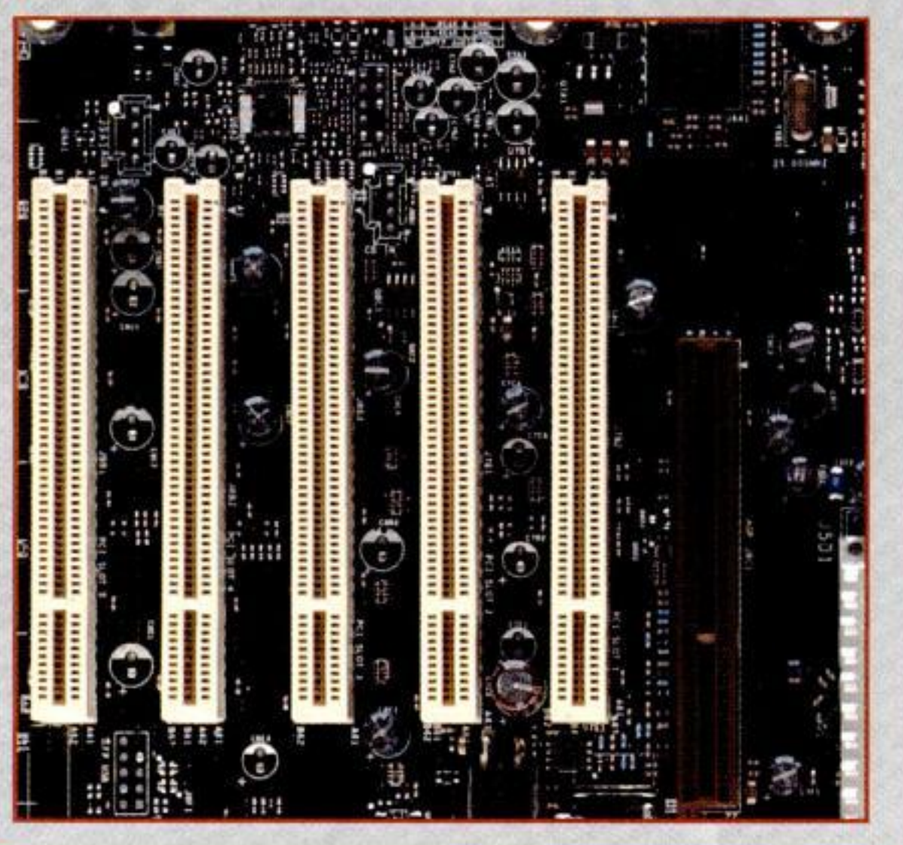
I/O Controller
Input/Output Controller. In the context of motherboards, the I/O Controller is, for most intents and purposes, another term for the Southbridge chip. There are some technical differences in the implementation of Southbridge chips and I/O Controller Hub chips, but they serve the same functions.

Memory Controller
The part of the Northbridge chip, or the CPU, which controls the exchange of data between the CPU and the main memory.

Northbridge
The component of the core logic chipset that primarily functions a memory controller, allowing the CPU to interface with main memory and the video card (AGP) slot (if the PC has one). In some systems, such as those based on the Athlon 64 processors, the memory controller is built into the CPU.

PC2700-3200
A labeling on DDR memory that denotes

PCI Slot
Peripheral Component Interconnect Slot. A multipurpose interface that allows the computer to accept all manners of expansion cards. The original PCI slot is 32-bits and operates at 33MHz. Today, there are 33 and 66MHz PCI slots, and slots which operate with 32 and 64-bits interfaces, but generally the slots are backwards compatible with older cards.



The standard interface for add-in cards is the PCI slot, which is white in color and runs at 33MHz.

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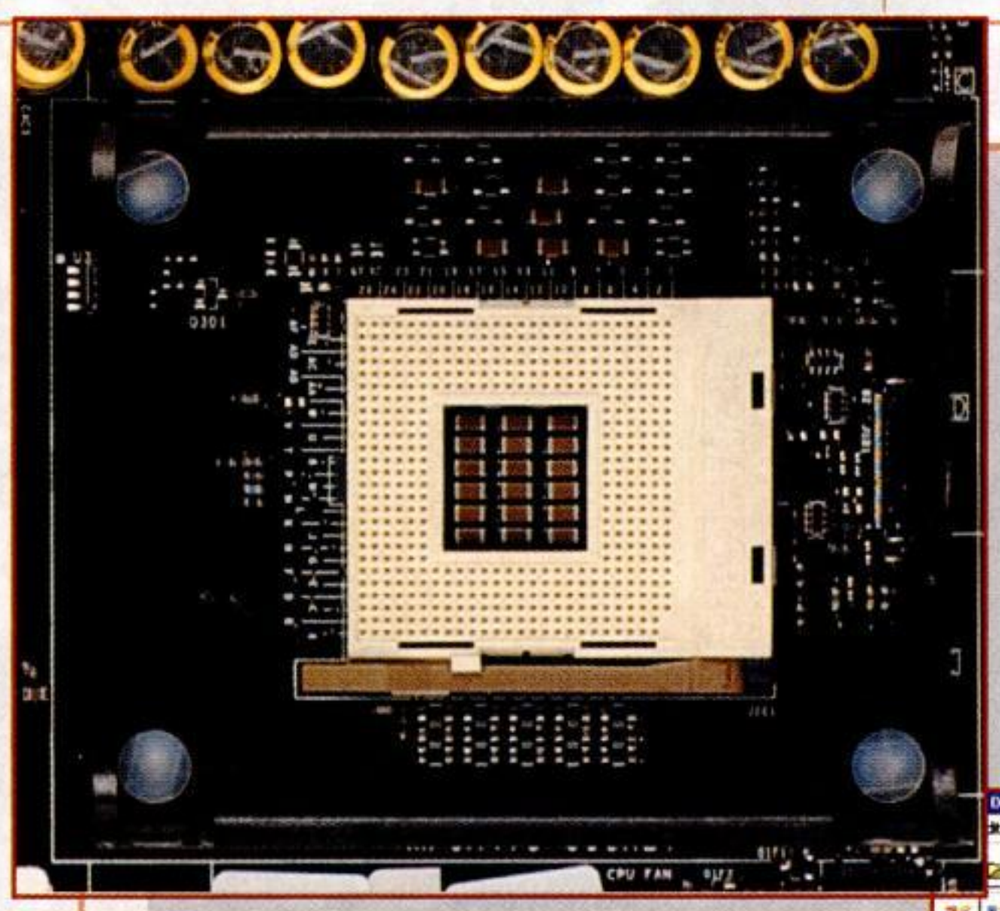
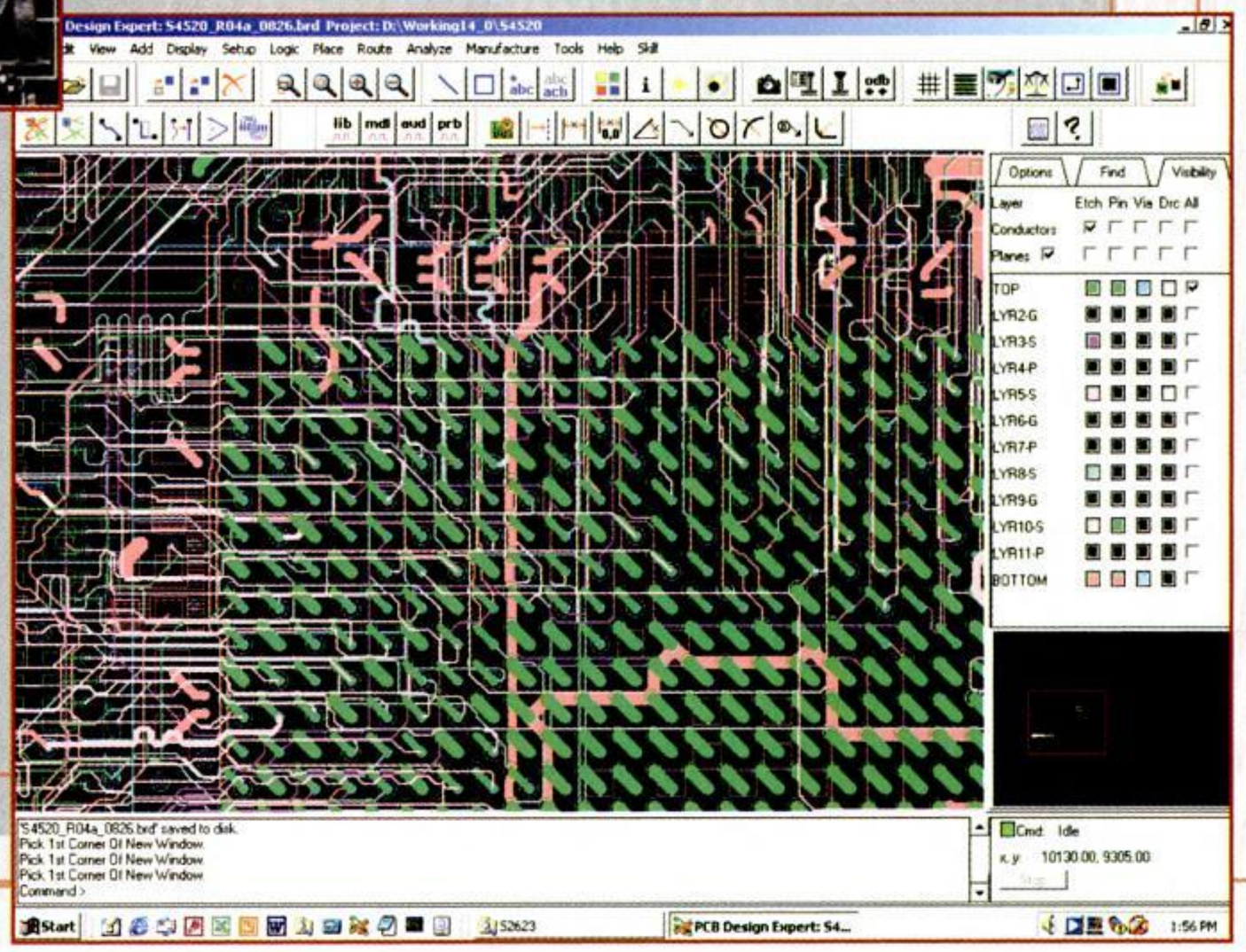


CPU Socket

This is where the star of the show settles in for a little number crunching. A CPU's pins are arranged in such a way that it can only be inserted into this socket one way, and one way only.

The CPU rests in its own little socket, but be careful handling CPUs--they're delicate!



Here we see a motherboard in its infancy. Mobos are mapped out in software prior to production using programs like this one, called *PCB Design Expert* (sorry, there's no demo of it on the CD!)

its bandwidth. PC2700 memory has a theoretical throughput of 2700MB/sec whereas PC3200 memory serves up 3200MB/sec. PC2700 memory is also known as DDR333 memory because it runs at 333MHz, while PC3200 and DDR400—which runs at 400MHz—are one and the same.

PCB

Printed Circuit Board. A board on which circuits are etched and chips are attached. A PCB is typically green in color but motherboards and video cards have appeared with a wide array of colored PCBs as of late.

PCI Express

This is the successor to the PCI slot, and will become the new standard for connecting peripheral cards to the PC in the next few years. Unlike the parallel PCI bus, PCI Express is a serial bus. PCI Express slots and cards are not interchangeable with conventional PCI cards. PCI Express should appear in PCs in mid-2004.

Power-On Self Test (POST)

The diagnostic tests that a computer performs on itself prior to booting its operating system. The Integrity of RAM and I/O interfaces are usually tested as part of the Power-On Self-Test regimen

SDRAM

Synchronous Dynamic Random Access Memory. Memory that synchronizes itself with the CPU's memory bus. Although DDR memory is technically a type of SDRAM, the term SDRAM typically refers to PC66/100/133 memory used in older computers.

Serial ATA

Serial Advanced Technology Attachment. This is a serial interface used for connecting storage devices to the computer, and it will replace the ATA interface, which is parallel. It uses a seven-pin connector that is much smaller than the 40-pin ATA interface cable. The first generation of Serial ATA interface is capable of a 150MB/s transfer speed as opposed to 100MB/s for ATA/100.

Southbridge

The component of the core logic chipset that provides the interface between the north bridge and the slower interfaces in the PC such as the PCI slots, USB, IDE and other I/O interfaces. In other words, everything other than main memory and AGP falls under the charge of the southbridge chip.

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MOTHERBOARD Cheat Sheet

You've got questions, we've got answers

These DDR400 memory sticks are sold in pairs for dual-channel operation

Question: What are the different types of memory currently being used and what new technologies are on the horizon?

A: DDR (double data rate) memory is by far the most popular type of memory in use today. While budget systems often use DDR in single-channel mode, high-performance systems usually boast a dual-channel memory configuration that allows for double the memory bandwidth when sticks of RAM are installed in pairs (for the Pentium 4 and Athlon) or threes (for the Athlon only). For power users, dual-channel is the only way to go.

The two types of legacy memory still lingering in older PCs are PC133 and Rambus RDRAM. PC133 is a holdout from the days of the Pentium III CPU, and is generally only found in older or low-end computers. Meanwhile, RDRAM was popular in high-end systems until about a year ago, when it was superseded by dual-channel DDR. Neither PC133 nor RDRAM have much of a future, so avoid them at all costs if you're building a new system.

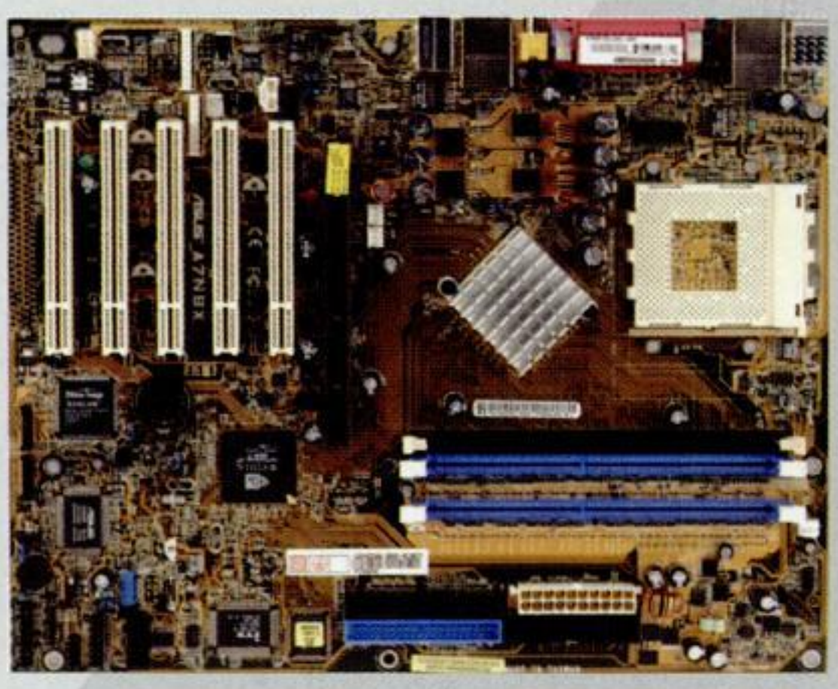
Looking to the future, DDR2 is expected to debut around the middle of 2004. This blazing-fast next-generation memory will not be backward-compatible with current DDR memory, so you'll need to buy a new motherboard (and, for Athlon 64 owners, a new processor) to take advantage of it.

Question: Which popular chipsets run which types of memory, and which memory is the fastest?

A: To get the most out of an Athlon XP system, you should use DDR memory clocked at the same speed as your CPU's frontside bus. That is, an Athlon XP that runs on a 333MHz bus will perform best in conjunction with DDR333 memory. The nVidia nForce2, VIA KT400, VIA KT400A, and VIA KT600 chipsets support all speeds of DDR up to DDR400—but only the nForce2 supports dual-channel memory, which is why we wholeheartedly recommend this chipset.

For folks running one of AMD's 64-bit processors, which feature on-die memory controllers, memory support is contingent on the CPU rather than the chipset. Both the regular Athlon 64 and the faster Athlon 64 FX support DDR400 memory (and the FX offers dual-channel capability as well). For best results, don't use anything slower than DDR400.

On the Intel front, you'll want to pair your Pentium 4 processor with dual-channel DDR400 memory for maximum performance. P4 chipsets offering dual-channel DDR400 support include Intel's 875P, 865PE, and 865G, ATI's Radeon 9100 IGP, VIA's PT600 and PT880, and SiS's 655FX. Of all these chipsets, only the 875P, 865PE, and Radeon 9100 IGP carry our recommendation.



Our favorite AMD-based motherboard chipset is the nForce 2—AKA the Kitchen Sink. It includes killer onboard audio, dual-LAN, FireWire, USB 2.0 and more

Question: Which are the best chipsets for the AMD and Intel platforms, and why?

A: If you're building an Athlon XP-based system, stick with the nVidia nForce2 Ultra 400 chipset, which offers first-rate performance and reliability that can't be touched by any of its competition. And unlike earlier nForce2 variants that only support up to a 333MHz front side bus, the Ultra 400 is guaranteed to be compatible with CPUs that ride the 400MHz bus.

The Athlon 64 is a different story altogether. We've had good results with nVidia's nForce3 150 and 250 and VIA's K8T800 so far, but both chipsets are too new for us to make a definitive recommendation.

In the Pentium 4 camp, our top picks are Intel's 875P and 865PE chipsets. The former is slightly faster, the latter is slightly cheaper. Both support all the latest technologies, such as 800MHz bus speeds and Hyper-Threading, but more importantly, Intel chipsets have long been the gold standard for reliability and compatibility. Regardless of which chipset you settle on, make sure any P4 motherboard you buy guarantees support for Prescott, Intel's next-generation processor core which should be available by the time you read this.

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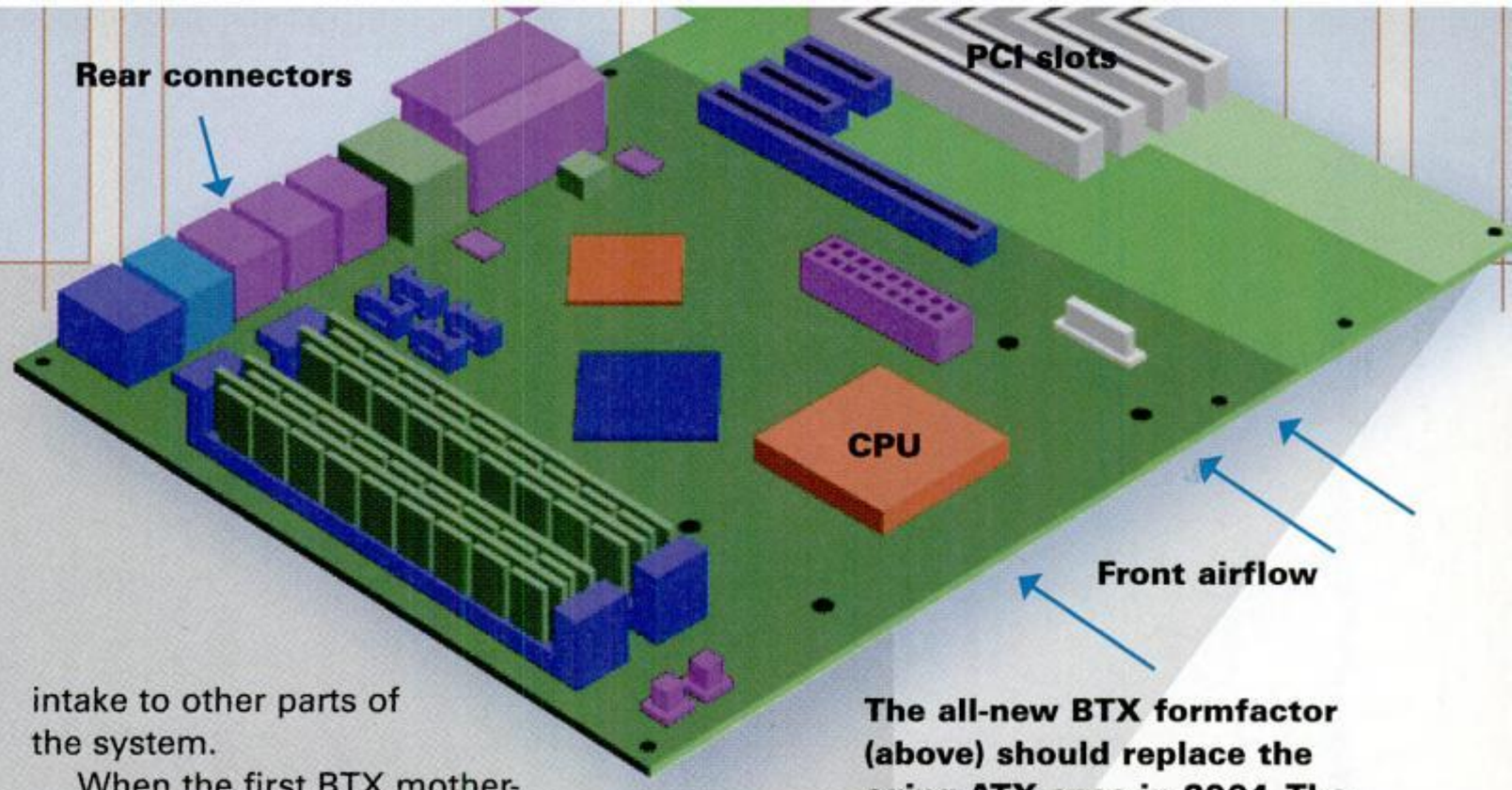


The all-new BTX formfactor (above) should replace the aging ATX spec in 2004. The new formfactor promises better airflow, among other things.

Question: What is the ATX spec and what are the details on its likely successor, the BTX spec?

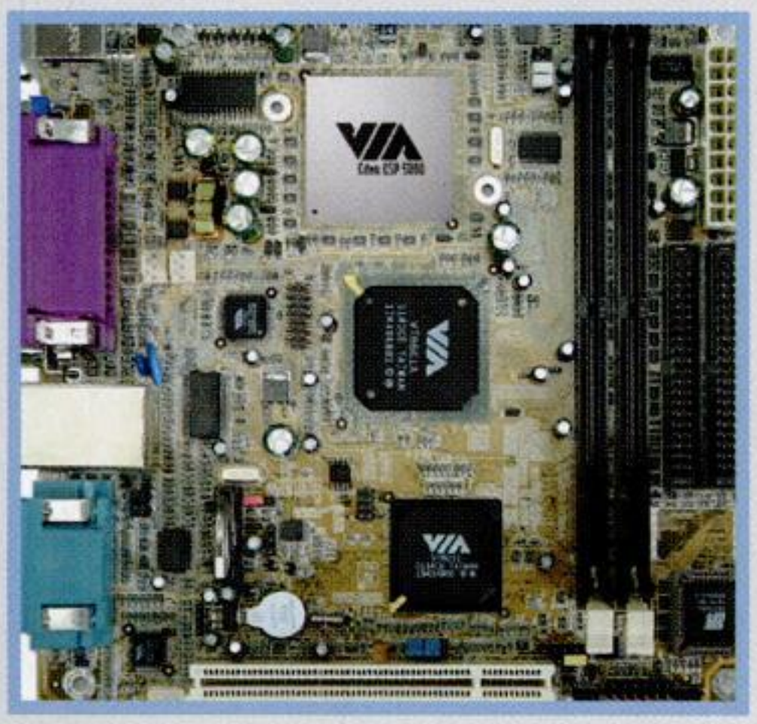
A: The ATX (Advanced Technology eXtended) spec was developed nearly a decade ago as the successor to the Baby AT standard. It is the most popular motherboard formfactor in use today, but it's starting to show its age. ATX's main shortcoming is that its designers did not anticipate the massive amount of heat generated by today's PCs. To address this problem, Intel is developing the BTX (Balanced Technology eXtended) spec to replace ATX.

The biggest differences between a BTX and an ATX motherboard is its layout. For instance, whereas the CPU socket on an ATX board is positioned towards the rear of the case, BTX places the CPU socket at the front of the case, right next to an intake fan. This allows the CPU to get cool air before any other component in the system. The CPU will also be enshrouded by a "thermal module" which directs air from the intake to other parts of the system.

When the first BTX motherboards materialize in mid-2004, they will be available in three different sizes: picoBTX, microBTX, and normal BTX (in order of increasing size). The first two are intended for smaller computers, while normal BTX is aimed at systems roughly the size of today's ATX mid-towers. Note that the ATX and BTX standards are completely incompatible with each other, with the exception of power supplies (an ATX power supply should work with a BTX motherboard, but we'll have to wait for hardware to arrive in order to know for sure).

Question: What features will the next generation of motherboards have?

A: A slew of important new technologies will appear on motherboards in 2004. In the first half of the year, PCI Express will blow away the 133MB/sec transfer rates of the erstwhile PCI bus with a bandwidth cap of up to 4GB/sec in each direction. Also keep an eye out for PCI Express Graphics, a high-bandwidth variant of PCI Express destined to replace the AGP bus. Meanwhile, DDR2 memory should emerge around the same time as both of these new data buses. You'll find all three of these technologies in new Pentium 4 chipsets from Intel (Grantsdale) and VIA (PT890), and as-yet-unannounced AMD64 chipsets from nVidia and VIA. Aside from that, look for next-generation motherboards to be offered in the new BTX formfactor, timed for release in mid-2004.



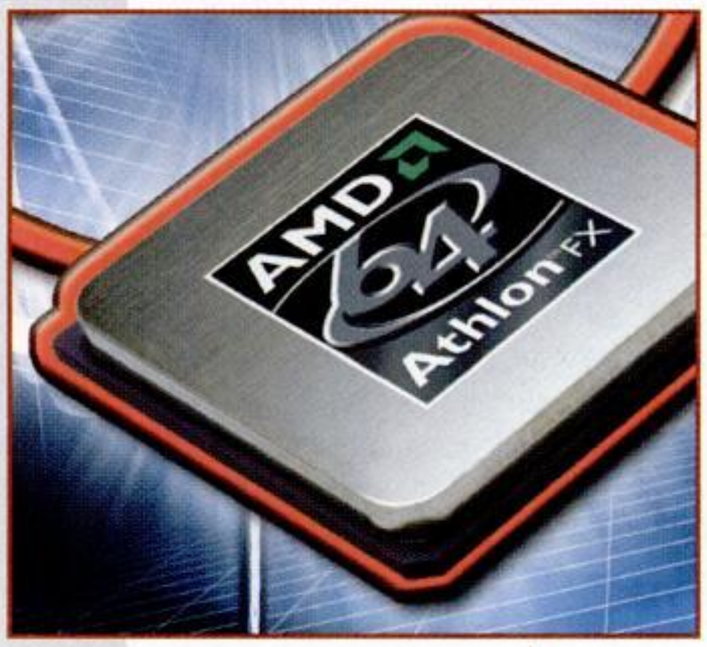
Question: What are the key differences among all the popular mobo formfactors?

A: Most of the motherboard formfactors in widespread use today are variants of the ATX spec. Plain-Jane ATX is by far the most common, and is characterized by the placement of the CPU and memory sockets above the expansion slots and a connector plate that includes all the basic I/O ports. The MicroATX formfactor retains the same basic design as its big brother, but is about 25 percent smaller. MicroATX mobos are primarily intended for smaller computers and typically feature integrated audio and video. Meanwhile, FlexATX is very similar to MicroATX but is even smaller, and is often found in one-piece computers or mini-systems.

Question: What are the benefits of moving the memory controller off of the motherboard and onto the CPU, as in the case of the Athlon 64? Will Intel follow AMD's suit soon?

A: The most obvious benefit is much faster memory access. The old method of using a motherboard-based memory controller caused data flowing between the controller and CPU to travel a relatively long distance, and be subjected to considerable signal noise from other components along the way. This limited the speed at which the FSB could reliably operate, and also increased latency, or the amount of time the CPU spends waiting for memory to respond to its requests. An on-die memory controller handily solves both of these problems. Whereas the Pentium 4's FSB canters along at 800MHz, the Athlon 64's runs at full CPU speed—that is, 2.2GHz for a 2.2GHz processor. Furthermore, AMD estimates that its integrated memory controller gives the Athlon 64 a latency of just 50 nanoseconds, or about half that of a Pentium 4 running on an 800MHz bus.

Given the very tangible benefits of an integrated memory controller, it would seem obvious that Intel would follow AMD's lead in the near future, right? Wrong. Chip design is all about making tradeoffs—adding more circuitry (such as a memory controller) to a CPU can make it faster, but it simultaneously decreases production yields and drives up the cost of the processor. For the time being, it would seem Intel has chosen to focus on other methods of improving CPU performance. Intel could plausibly add an on-die memory controller in the future, but it would be more of an economic decision than anything else.

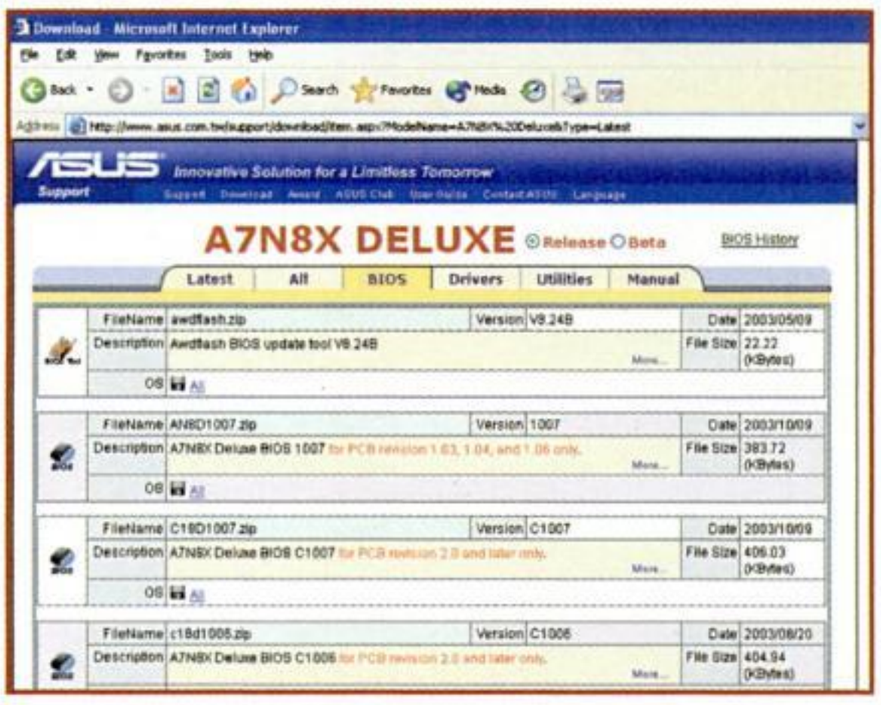


UPGRADING YOUR BIOS & INSTALLING CHIPSET DRIVERS

Chances are the BIOS that came with your motherboard works just fine. However, if you are interested in obtaining the absolute maximum level of performance from your PC you'll want to make sure the BIOS is up to date. To do this, you must occasionally update (or "flash") your BIOS. It's a tricky process that can kill your PC if performed carelessly. But have no fear—we'll hold your hand and show you how it's done.

Step 1.
Prepare your system for the BIOS flash

Head over to your motherboard manufacturer's web site and locate your specific model to find the latest BIOS update. Make dead certain you download the right BIOS, because if you inadvertently use the wrong one, your motherboard will be transformed into a silicon key fob. Also, some mobo manufacturers require you to separately download a flash utility with which to update the BIOS, so do this if necessary.



Step 2:
Put the BIOS files on a floppy disk

Dig up a floppy disk (remember those?) and format it as an MS-DOS boot disk. To do this in Windows XP, open My Computer, right-click on your floppy drive, and click Format. Check the "Create an MS-DOS startup disk" option, and then click Start. Once the disk is ready, copy the BIOS file and the flash utility to the floppy disk, and then restart your computer and enter the BIOS (usually done by pressing Del or F2). Locate the Advanced BIOS Setup or Boot menu and make sure your system is set to boot from the floppy drive. Also, some motherboards have a setting called "BIOS Flash Protection" or something similar—if such an option exists, disable it. Finally, save and exit the BIOS.

Step 3:
Flash the BIOS

After you exit the BIOS, your computer should automatically restart and boot from the floppy disk you created in the previous step. Once you see the DOS prompt, run the flash utility executable and, when prompted, enter the name of the BIOS file you copied to the floppy disk. At this point, you'll be given a chance to back up your existing BIOS to disk in case the new BIOS screws up your system—do so. The updating process should now begin. Do not turn off or restart your computer during this process, as doing so will render your motherboard useless. When the flash is complete, you'll be prompted to remove the floppy disk and restart—you're done! Be forewarned that if the update procedure fails for any reason, your mobo will most likely be hosed. *Maximum PC* assumes no responsibility if this occurs! However, as long as you don't do anything stupid (like flashing your BIOS during a lightning storm), the likelihood of failure will be rather small.

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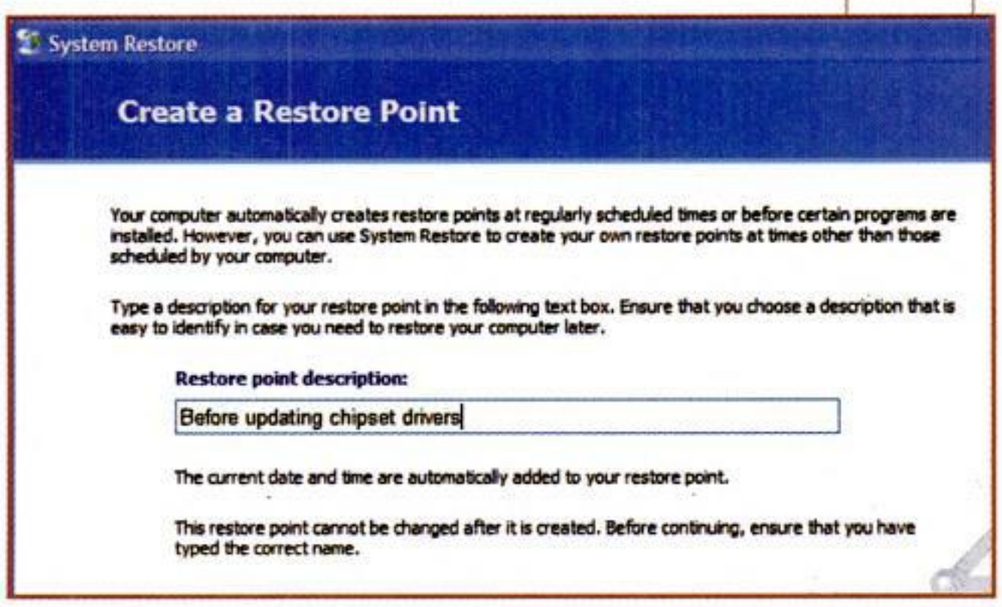


Before installing chipset drivers--or any drivers for that matter--be sure to create a system restore point just in case the new drivers cause instability.

Don't forget your chipset drivers!

Believe it or not, most of the computer problems we hear about at *Maximum PC* can be solved simply by updating the chipset (or "4-in-1") drivers. To get the latest drivers, go to the web site of the company that made your chipset. Drivers will probably also be available from your motherboard's manufacturer, but they may not be the latest and greatest. Chances are your chipset was made by one of the following companies: Intel (www.intel.com), AMD (www.amd.com), nVidia (www.nvidia.com), SiS (www.sis.com), VIA (www.viaarena.com), ALi (www.ali.com.tw), or ATI (www.ati.com). Once you've downloaded the drivers, close all open applications and disable any anti-virus software that may be running in the background. At this point, we recommend setting a Windows XP System Restore Point in case the new drivers cause any problems. From the Start menu, open Programs, Accessories, then System Tools, and click on System Restore. Follow the step-by-step instructions to create a restore point. Finally, go ahead and install the chipset drivers, rebooting your computer when prompted to.

What are the Ten Coolest BIOS Tweaks and how do I set them?

1. CPU and FSB Speeds: Make sure your CPU is operating at full speed by heading into either the Frequency/Voltage Control menu or the Advanced menu and verifying that the frontside bus (FSB) setting is correct. Motherboards commonly default to 100MHz, but most newer processors are designed for a higher FSB speed. Consult your CPU manufacturer's web site to see what FSB speed your particular processor requires.

2. Memory Speed: The setting that controls the operational frequency of your memory is usually located in the same menu as the FSB speed. In general, the faster your memory runs, the better—but beware that exceeding your memory's rated speed (that is, overclocking) could compromise stability.

3. Memory Timing Settings: Usually located in the Advanced Chipset screen or a submenu of this screen, memory timing settings affect your system's performance and stability. Choose the "Auto" or "By SPD" option for optimal stability, or experiment with lower CAS latency settings to try and squeeze some extra performance out of your system.

4. AGP Settings: AGP bus settings are usually found in either the Advanced Chipset or AGP menus. Set the AGP mode to the maximum supported by your motherboard (usually 4x or 8x). We also recommend enabling fast writes and specifying an aperture size of either 64MB or 128MB.

5. IDE Settings: Check the Standard CMOS Features menu to ensure that all your IDE drives have been properly detected. Also, enable S.M.A.R.T. (on either the same menu or the Advanced CMOS/BIOS Features menu) to monitor your hard drives for possible problems. Then open the PnP/PCI or Integrated Peripherals menu and enable the PCI IDE Bus Master setting.

6. Temperature Monitoring: Protect your CPU from overheating by setting a warning and/or emergency shutdown temperature on the PC Health Status or Power Management menu. You should also enable CPU Fan Detection, which will shut off your system in the event of a CPU fan failure.

7. Cache-related Settings: To maximize performance and stability, we suggest disabling the PCI Master Read Caching and System BIOS Cacheable options (both in the Advanced Chipset Features menu). In the same menu, ensure that your CPU's Level 1 and Level 2 caches are enabled (this setting may also be called "CPU External Cache").

8. Disable Unused Drive Controllers: If your motherboard has onboard RAID, Serial ATA, or floppy disk controllers you aren't using, disable them in the Integrated Peripherals menu to reduce your system's boot time. If you don't have a floppy drive, you should also hit up the Standard CMOS Setup menu and set the Floppy Drive A option to "Not Installed."

9. Boot-up Options: Set your hard drive (or RAID controller, if applicable) as the first device in your boot sequence to make your system boot faster. This setting is usually found on the Advanced BIOS Setup or Boot menu. While you're there, enable the Quick Boot/Quick Power On Self-Test (POST) option, and disable Floppy Drive Seek.

10. Integrated Peripherals: Chances are your motherboard came with at least one built-in feature you aren't using. Hop on over to the Integrated Peripherals or Features menu to disable any and all extraneous functionality, including onboard sound, video, modem, and Ethernet. This will free up system resources and reduce the likelihood of a device conflict.

Ask the Doctor

Your PC is sick, and we've got the cure

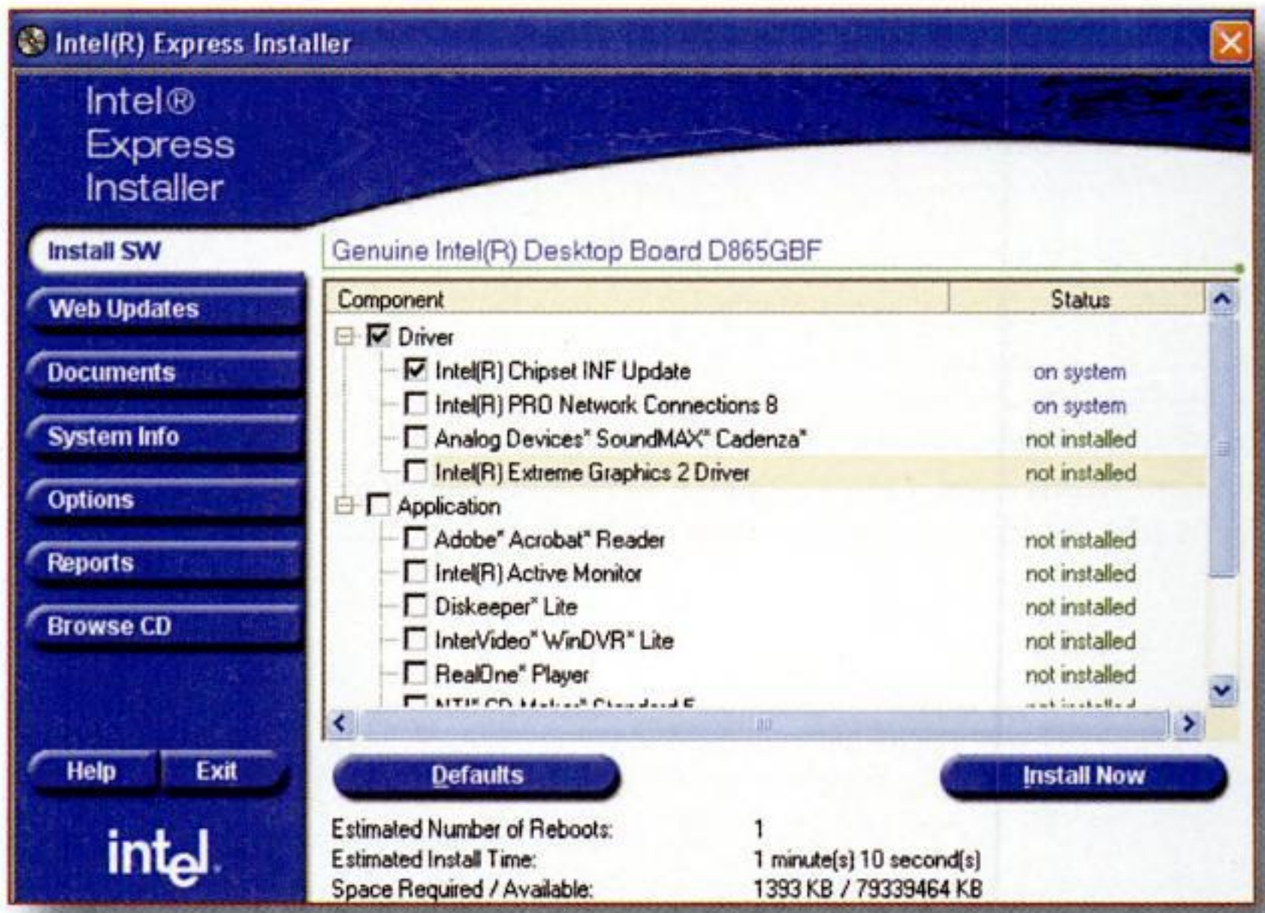
WHO'S IN THE DRIVER'S SEAT?

I've seen you stress the importance of chipset drivers many times in Ask the Doctor. So I decided to update the drivers on my old Dell Dimension 4100. Using an Intel chipset identification utility, I discovered that I had an 815 Intel chipset and found at least five driver updates for it on the Intel web site.

However, Intel tells me that my system is an OEM version of an Intel Desktop Board BIOS and advises me not use its drivers, but to instead call my PC manufacturer for advice. That's right, you guessed it! Dell does not offer chipset update drivers. Is it safe to precede with the Intel drivers?

The Doctor thinks you're confusing two different things: chipset drivers and your motherboard's BIOS. We don't recommend you try to install a BIOS—the software that resides in a chip on your motherboard and tells your OS how to access all the nifty features of your PC—for any board other than the one that's specified. That's a sure-fire way to kill your PC. It sounds to us like you're interested in updating your Dell mobo with an Intel BIOS, which would be bad.

On the other hand, chipset drivers work on any boards that use the chipset in question. Most of the chipset vendors make one driver that will work with all their modern chipsets for convenience.



Intel lets you update chipset drivers manually or automatically over the Internet.

WINDOWS ACTS WACKY

I'm having trouble getting my new PC working. It's an Athlon XP 1800+, with 256MB of RAM, and a pair of 40GB Maxtor drives in a RAID 0 array. I can't get the machine to work properly. When I try to install Windows to the RAID array, Windows locks up, even though I am using the correct drivers for my RAID controller.

If I install Windows to one of the drives without RAID, Windows works OK for a while, but eventually I get crashes when I'm playing Battlefield: 1942. The system won't reboot, and I get an error in NTFS.sys or kern32.sys. Please help!

The Doctor had a similar problem with one of his machines recently. Assuming you're not overclocking, which can really bork 3D and PCI devices, we'd bet your problem is bad memory. A bad stick of RAM or a faulty slot on the mobo is the most common cause for this sort of problem.

To test it, open your case and remove one stick of RAM, then fire up the PC, and see how things run. If that fixes your problem, the RAM you removed is likely faulty. If it's still wonky, swap the stick you removed with the stick that's still in the system, and try again. You should also try moving the memory to the other slots in your mobo.

If your RAM tests OK, your motherboard could be faulty. The only way to confirm that is to swap your mobo with another mobo, and see what happens.

If your system shuts off randomly, it's probably due to excessive heat. If your CPU's heatsink/fan aren't doing their job, you may need an aftermarket unit like Thermaltake's Volcano 7.

CAN'T TAKE THE HEAT

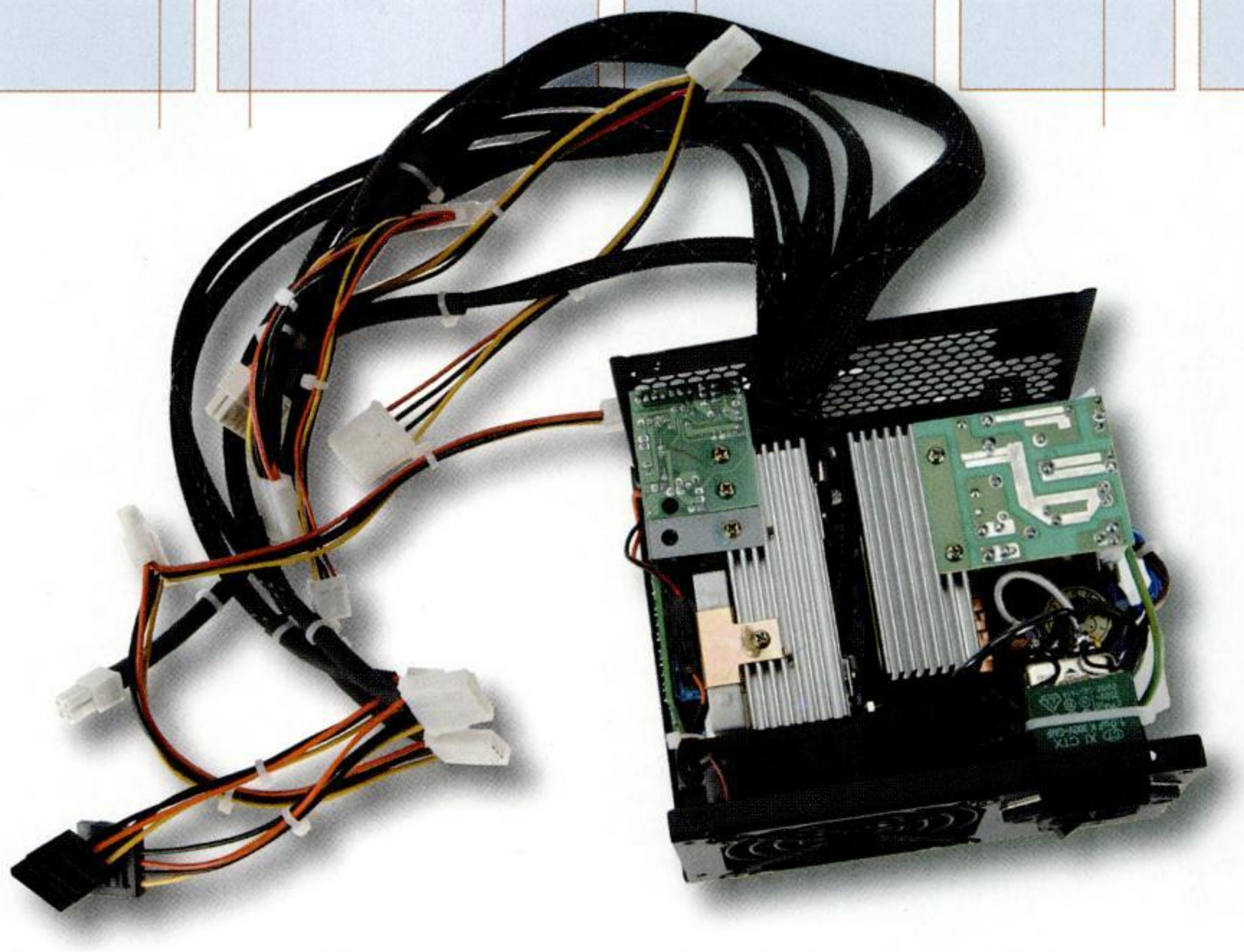
Q: I just installed a new processor, and as soon as I start playing 3D games my PC just shuts off. What is happening?

Sounds like you didn't install the CPU's heatsink properly, as random shutdowns are almost always due to overheating. Some motherboards have built-in temperature sensors that will shut the PC off once temperatures breach preset thresholds in an attempt to save your CPU from meltdown. Our advice is to remove the heatsink/fan from your CPU, make sure it is being mounted correctly, and remount it. Also, if you aren't using any type of thermal compound to increase the efficiency of your CPU's heatsink we highly recommend applying a dab onto the top of the CPU prior to mounting the heatsink.

THE CASE FOR ATX

I am looking to buy a new case, but how do I know for sure that my motherboard will fit properly?

All cases and motherboards are designed to a certain specification, which is called it's "formfactor." There are several formfactors, but as long as the one for your case matches the one for your motherboard you will be fine. The most common formfactor for desktop machines is called ATX and it's what you would call the typical "tower" PC, that stands a few feet tall and is quite large. The majority of both cases and motherboards conform to the ATX specification, and are all interchangeable. That is, any ATX motherboard will fit into an ATX case. In fact, an ATX case will fit several variants of the ATX specification, but it makes little sense to buy a big ATX case if you want a smaller Micro-ATX motherboard. The bottom line for matching cases to motherboards is to make sure the specifications match—it's that simple.



The power supply is one of the most important, yet most often-overlooked, components in a PC.

MEMORY BOOSTER?

I have an Athlon XP board running PC2700 (333MHz). should I upgrade to PC3200? Is it worth it?

The first question here is actually, "will my motherboard support a 400MHz bus?" Not all Athlon XP motherboards support this faster bus speed, so be sure to consult the website of your motherboard manufacturer to see what bus speeds are supported. If a 400MHz bus is supported, by all means upgrade away! nForce 2 motherboard owners should pay special attention to this situation as some nForce 2 motherboards shipped with support for a 333MHz front side bus, but are able to go up to 400MHz with an updated BIOS from nVidia. Once again, be sure to check nVidia's website to see if your board revision will support the faster bus speed. Also note that if you are currently running PC2700 you will have to upgrade your memory as well since PC2700 only runs at 333MHz. You'll need PC PC3200, which is also known as DDR400, to run at 400MHz.

MORE POWER SCOTTY!

How important is the power supply when upgrading?

Extremely important. In fact, if you're considering a major upgrade (CPU and motherboard), the power supply is the best place to start. Today's CPUs require a lot of juice, and when you consider that you might have to plug your videocard into the power supply as well, along with all your other add-in cards, you begin to understand how a steady supply of ample power will go a long way towards creating a stable system. As a baseline we always recommend a 350 watt power supply for most "power user" type systems. In general, that should be more than enough power to run a very fast system with as many peripherals plugged into it as your heart desires. You should also purchase a high quality power supply from a known company, rather than some cheapo unit that might save you a few bucks. We highly recommend power supplies from Antec (www.antec.com) as well as PC Power and Cooling (www.pcpowerandcooling.com) ■

The ATX formfactor is the de rigueur standard for today's performance-oriented desktop machines, as demonstrated by this gorgeous system from Falcon Northwest.

VID

Q If I buy a top-of-the-line videocard today, how long will it be a viable solution for good gaming?

In general, a high-end videocard should be extremely capable for at least a year, and maybe longer depending on what kind of frame rates you demand and the kind of features you'd like to be able to use. There are actually games out today that run just fine on 3-year-old cards, but that's only because the 3D engine used in the game came out at roughly the same time as the card. Play a next-gen game on this same card, though, and it will be like watching a slide show, if the game runs at all.

While the videocard industry generally relies on a six-month refresh cycle for all of its cards, the game development industry moves at a much slower pace. You see, all games use a certain 3D engine, which is a massive pile of code that determines the visual quality of the game you see on the screen. These engines take years to develop and are as forward-looking as possible, meaning they are designed to run on whatever hardware will be in consumers hands several years down the road. Because of the 3D engine's life cycle, these engines are brutal on hardware when first released, but over time the hardware catches up and eventually surpasses the 3D engine's capabilities. A classic example is id software's *Quake III* engine. When it was first released several years ago, nothing but the most high-end card available could play that game at 30 frames per second. Today, the latest hardware runs that engine at over 200 frames per second! All that is about to change, though, as id software is preparing to release its all-new engine for its upcoming game, titled *Doom 3* and that will surely drop any videocard on the market to its knees. Then, in three more years, we'll laugh at the *Doom 3's* engine's simplicity.

Q Is there anything I can do to extend my videocard's lifespan?

There is indeed a way to extend a videocard's life cycle, and it's called "overclocking." This practice allows you to run a videocard's processor and memory at faster speeds than the stock settings, but, like CPU overclocking, it voids your warranty and can be detrimental to your videocard's life expectancy. Also, overclocking won't help you when a massive jump in frame rates is required to play a next-gen game. At best, you'll see a 5 percent to 10 percent increase in performance, but if a next-gen game is released and you have older hardware, it might just be unacceptably slow.

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VIDEOCARDS

The one component that's almost worth its weight in gold!

nVidia's GeForce FX 5950 videocard is a 3D processing behemoth with 256MB of onboard memory and a cooling solution big enough for a small four-cylinder engine.

If there's one overarching need for a PC that is powerful enough to be classified as a weapon of mass destruction, it's gaming. Having a super-fast CPU, lightning-quick memory, and enough fans to cause a brown out doesn't do much for Microsoft *Word* or *Instant Messenger*, but for today's games, you simply cannot bring a knife to a gunfight.

The most important weapon in your gaming arsenal is, of course, the videocard. Although there used to be two separate types of videocards—2D cards for desktop work and 3D cards for games—today's videocards do everything in one sexy silicon package. And over the years, as games have become increasingly complex and more life-like, videocard development has accelerated rapidly in an attempt to bring *Finding Nemo* graphics to the desktop. While that day is still far off in the future, modern videocards are technological wonders that are just as complex (and just as expensive, unfortunately) as high-end CPUs.

The consumer videocard market is currently owned by two companies—ATI and nVidia. While nVidia held the speed crown all by itself for the past few years, ATI has come on like gangbusters during the past year. Today, these two rivals' top-of-the-line products—ATI's Radeon 9800XT and nVidia's GeForce FX5950 Ultra—are literally neck-and-neck in terms of performance and price. However, we'd advise those in the market for a new videocard to enter a holding pattern until a few things are cleared up in the upcoming year.

Both nVidia and ATI are poised to release all-new product groups this summer. ATI's new core is dubbed R420 while nVidia's new tech is labeled NV40. Both companies typically release a product family and then launch incremental speed increases for the 18 months following the initial release. NV40 and R420 are all-new technology though, and, as such, should represent a huge leap forward in graphics processing technology.

These new cards could not have arrived at a more prescient time, either, because of the two major game engines—used in many of the games on the market today—are being completely overhauled in 2004 (we hope), with the release of *Half-Life 2* and *Doom 3*. Both of these games include every next-gen feature available and will be serious ballbusters for low-to-midrange videocards. These games are so eagerly anticipated, in fact, that their release will spawn a wave of upgrading across the PC landscape.

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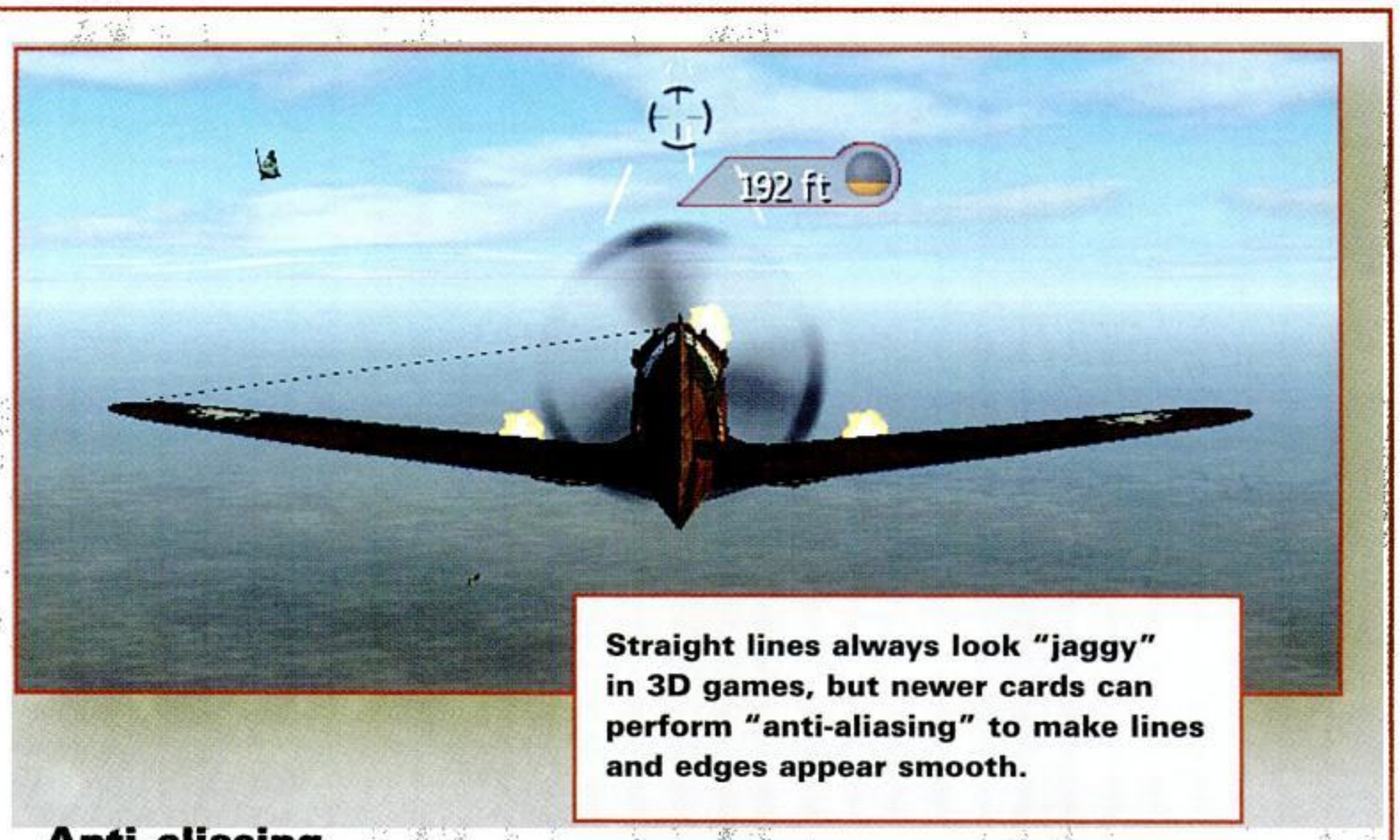
Tech Terms

All the specs and tech lingo explained



Straight lines always look "jaggy" in 3D games, but newer cards can perform "anti-aliasing" to make lines and edges appear smooth.

Anti-aliasing
A technical term that translates loosely to the blurring or smoothing of graphics. Anti-aliasing reduces the appearance of "jaggies" in straight lines in a game scene. Anti-aliasing can reduce the jagged appearance of graphics, but it also results in a reduction in sharpness.

AGP
Accelerated Graphics Port. A graphics card interface developed by Intel that provides the graphics controller direct access to the PC's main memory. The AGP interface has been improved over the years and is now denoted as 2x, 4x, and 8x AGP. 8x AGP indicates that the interface provides a theoretical bandwidth of 2.1GB/sec, eight times higher than that of the original AGP standard.

AGP Fast Write
AGP Fast Write is a scheme that allows data to be sent directly from the CPU to the videocard without first placing it in main memory. This affords a small performance boost but works only if it is supported by both the videocard and the motherboard.

Anisotropic Filtering
A function performed by the videocard that reduces the tiresome shimmering effect that is common when high-resolution textures are moved from the foreground to the background.

API
Application Programming Interface. A set of protocols, subroutines, and data structures that makes it easier for a programmer to produce a sophisticated program by presenting what is akin to ready-made building blocks. Microsoft's DirectX is an API, as is OpenGL.

Bilinear/Trilinear Filtering
Two axes and three axes filtering, respectively. A bilinear filtering process only takes into account nearby pixels on a single mip-map level, whereas trilinear filtering considers proximate pixels on more than one mip-map level.

Core Clock Speed
The speed at which the GPU, or "videocard core," operates.

DDR
Double Data Rate. DDR refers to the memory technology that transfers data on both the rising and falling edge of the clock, thereby permitting twice the amount of data to be transferred for any given clock speed. DDR memory is a common type of memory used in graphics cards today.

Direct3D
A graphics API developed by Microsoft for processing and displaying 3D graphics. Direct 3D is supported by practically all modern videocards.

DirectX
DirectX is a cross-platform code base written by Microsoft that allows game programmers to access hardware features on a computer without exact knowledge as to what kind of hardware is installed. This allows developers to work on next-generation effects years before they're officially supported by videocards that are available to the public.

Drivers
The software that is required for the videocard to work properly with the operating system. Performance and compatibility problems with a videocard frequently can be addressed by installing the newest drivers.

DVI
Digital Visual Interface. An interface that connects a monitor with a videocard. Most LCD displays support the DVI interface, and produce better image quality when it is used. Despite the word "Digital" in its name, a DVI connector actually outputs both digital video signals and the legacy analog video signals. An adapter can be used to hook a traditional VGA connector to the DVI interface.

Floating Point Color
Floating Point Color allows color information to be defined more accurately, with the use of decimal points. This is one of the new features introduced with DirectX.

Hardware T&L
Hardware Transform & Lighting. The hardware acceleration of T&L functions provided by a videocard. This process, during which a scene is constructed in wire frame mode and lit, used to be performed by a system's CPU but is now accomplished by a videocard's GPU. The offloading of this work from the CPU frees it to perform other tasks, ultimately improving performance.

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Memory Speed
The speed at which the dedicated graphics memory on the videocard operates.

Memory Bandwidth
The rate at which the memory on the videocard can be accessed by the GPU. Memory bandwidth is usually expressed in gigabytes per second (GB/sec), with the best videocards boasting figures over 20GB/sec.

Open GL
A graphics API first developed by Silicon Graphics Inc. for processing and displaying 3D graphics.

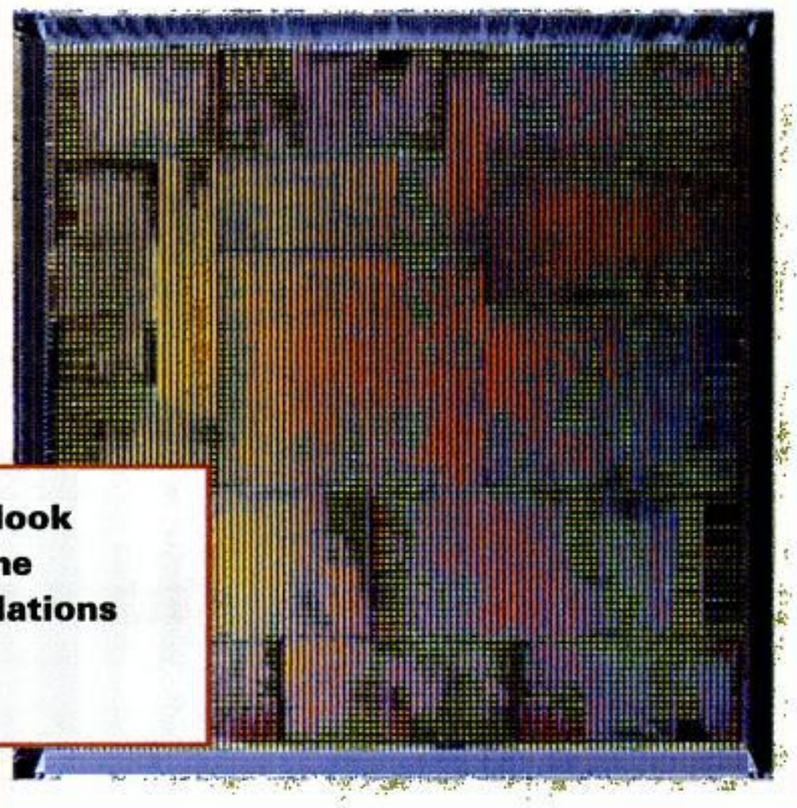
Programmable Shaders
Programmable shader units are the areas of GPUs that can run generalized programs rather than fixed 3D functions. There are two basic types of programmable shader units: pixel and vertex.

RAMDAC
Random Access Memory Digital-to-Analog Converter. Circuitry that converts data from the video memory into analog signals that can be displayed by the monitor. A fast RAMDAC is necessary to produce flicker-free images at high resolutions.

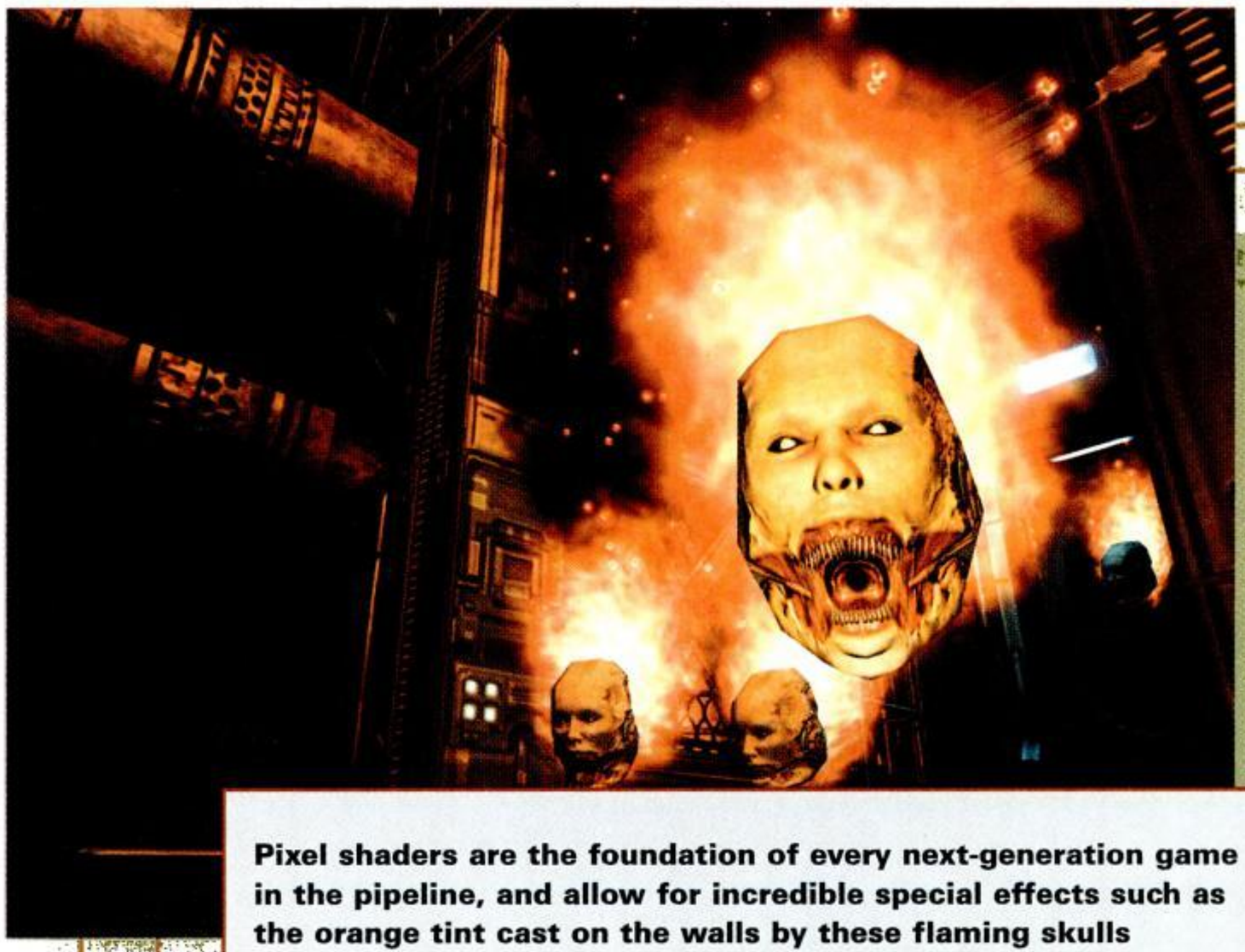
Vertex Shader
A programmable shader unit that specializes in geometry calculations. Vertex shaders handle terrain morphing, some lighting calculations, and some shadow calculations.

Vertical Sync
Vertical Synchronization or *V-Sync*, is the signal that tells the monitor when to draw the next vertical line. The rate at which V-Sync occurs is also known as the "refresh rate." Enabling V-Sync in a game prevents the game from running faster than the monitor's refresh rate, which can cause textures to "tear" or look distorted.

GPU
Graphics Processing Unit. A specialized chip on the graphics card that accelerates mathematically intensive graphic tasks such as applying effects and textures to 3D objects. Just like a CPU does all the computing for basic desktop tasks, the GPU does all the heavy lifting in 3D gaming.



This is what a GPU looks like if you look really, really close. It's the heart of the videocard and performs all the calculations needed to draw a game's 3D images.



Pixel shaders are the foundation of every next-generation game in the pipeline, and allow for incredible special effects such as the orange tint cast on the walls by these flaming skulls

Pixel Shader
A programmable shader unit that manipulates individual pixels. Pixel shaders can create bump maps (a layer of "skin" that goes on top of a texture, allowing for dimples or bumps to appear on a model), reflective surfaces, dynamic shadows, and all sorts of "Wow!" effects.

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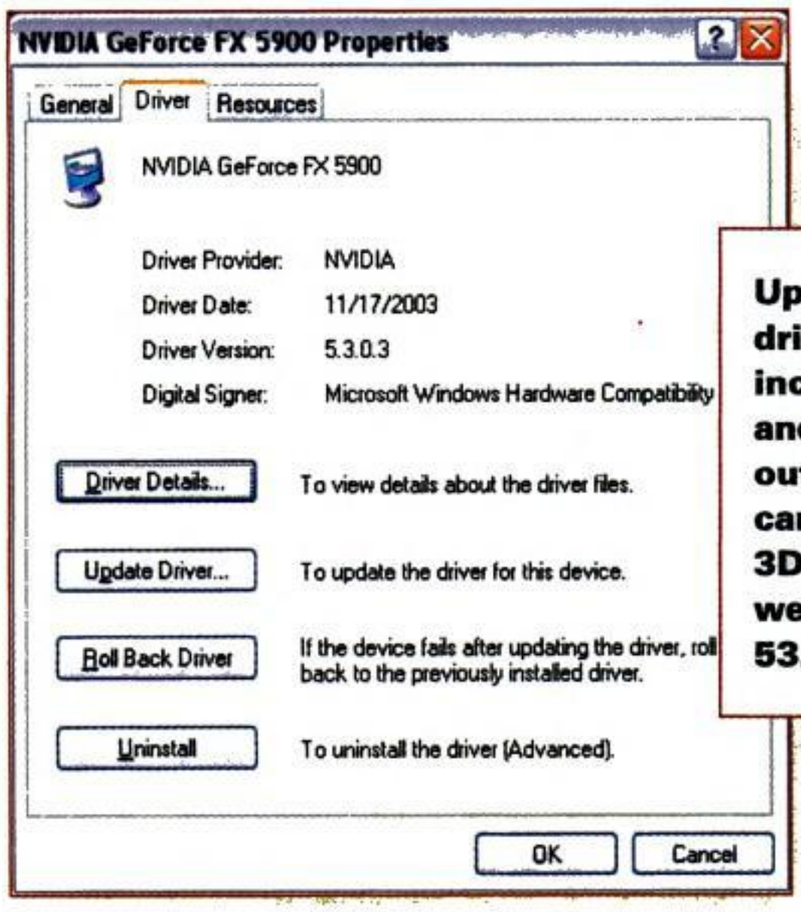
VIDEOCARDS Cheat Sheet

You've got questions, we've got answers



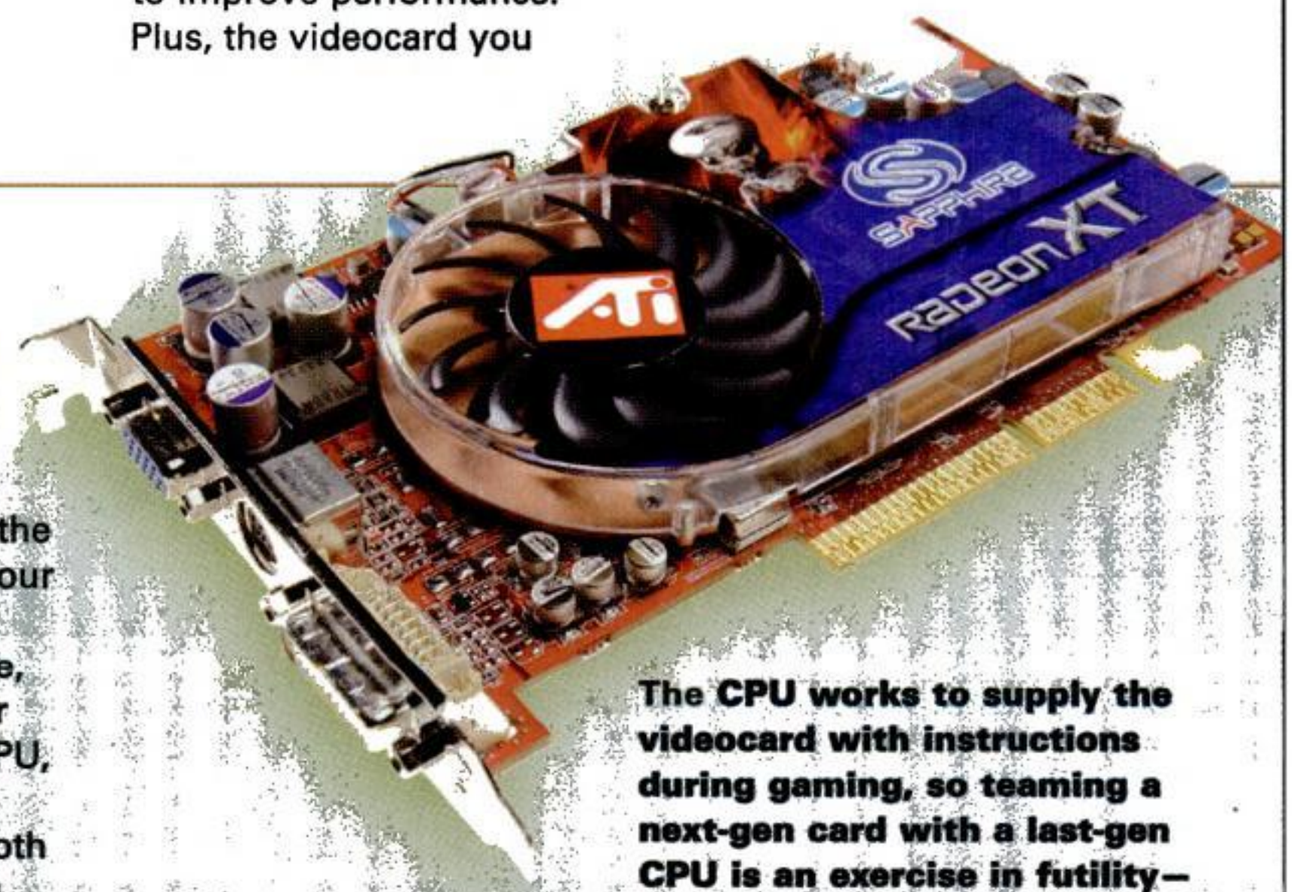
Updated videocard drivers often will increase performance and resolve any outstanding issues a card has with popular 3D games. This says we're using version 53.03 of nVidia's drivers.

Question: Which drivers should I use? The ones from the card maker or from the chipset manufacturer?

A: It's generally best to use the latest drivers from the maker of your videocard's chipset, since these drivers are constantly being updated to add new features and to improve performance. Plus, the videocard you purchased could have been sitting on the store shelf for a few months, so the drivers on the included CD may be quite old. nVidia and ATI have both kept a breakneck pace of driver development as of late, with new revisions coming out almost monthly, so check the maker of your videocard chipset's web site often for new drivers.

Question: I have a 2-year-old computer. Should I upgrade to a top-of-the-line videocard or upgrade my CPU/motherboard instead?

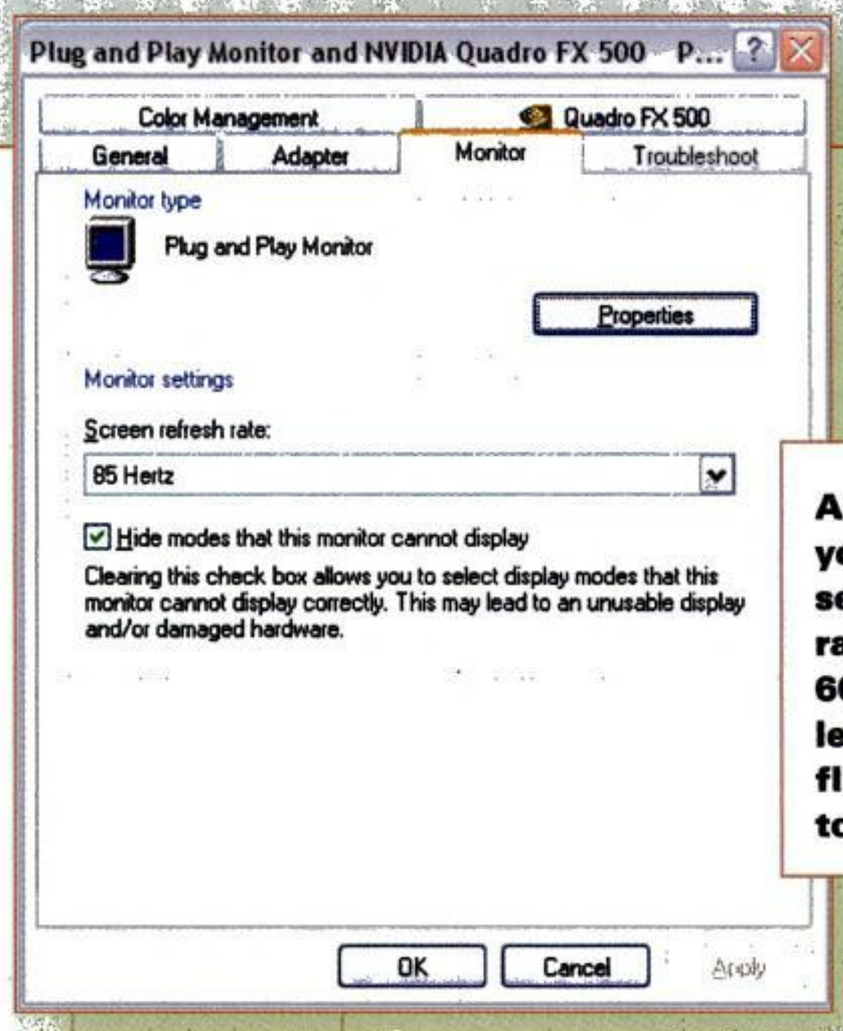
A: It makes no sense to upgrade to the fastest videocard in the world when you have a last-gen CPU that's incapable of keeping the GPU supplied with fresh instructions. Your best bet is to spread your upgrading money around by staying one or two rungs below the top-of-the-line and getting a new CPU *and* videocard. For instance, if you have a Pentium 4 1.6GHz and a GeForce 2 videocard, rather than spending all your money on a new videocard or a 2.8GHz CPU, buy a 2.4GHz CPU and a midlevel videocard like the GeForce FX 5700 or Radeon 9600XT. That way your CPU and videocard will both receive an upgrade and will be quite evenly matched. Also, if you are only running 256MB of memory, you should definitely consider a RAM upgrade prior to upgrading other key components, as adding more memory to your system is one of the best "bang for the buck" upgrades you can perform.



The CPU works to supply the videocard with instructions during gaming, so teaming a next-gen card with a last-gen CPU is an exercise in futility—the CPU simply won't be able to keep up.

Question: What is the lowest refresh rate I should be running?

A: For CRTs, any refresh rate less than 75Hz is too low, and we prefer 85Hz. Higher refresh rates are better for your eyes, and won't give you the blinding headache that comes as a result of screen flicker. DVI flat panels are a slightly different story because they don't have a refresh rate, per se. Your DVI panel likely will default to 60Hz, and that's just dandy.



As a rule of thumb, you should always set the refresh rate higher than 60Hz. Anything less can cause flickering and lead to headaches.

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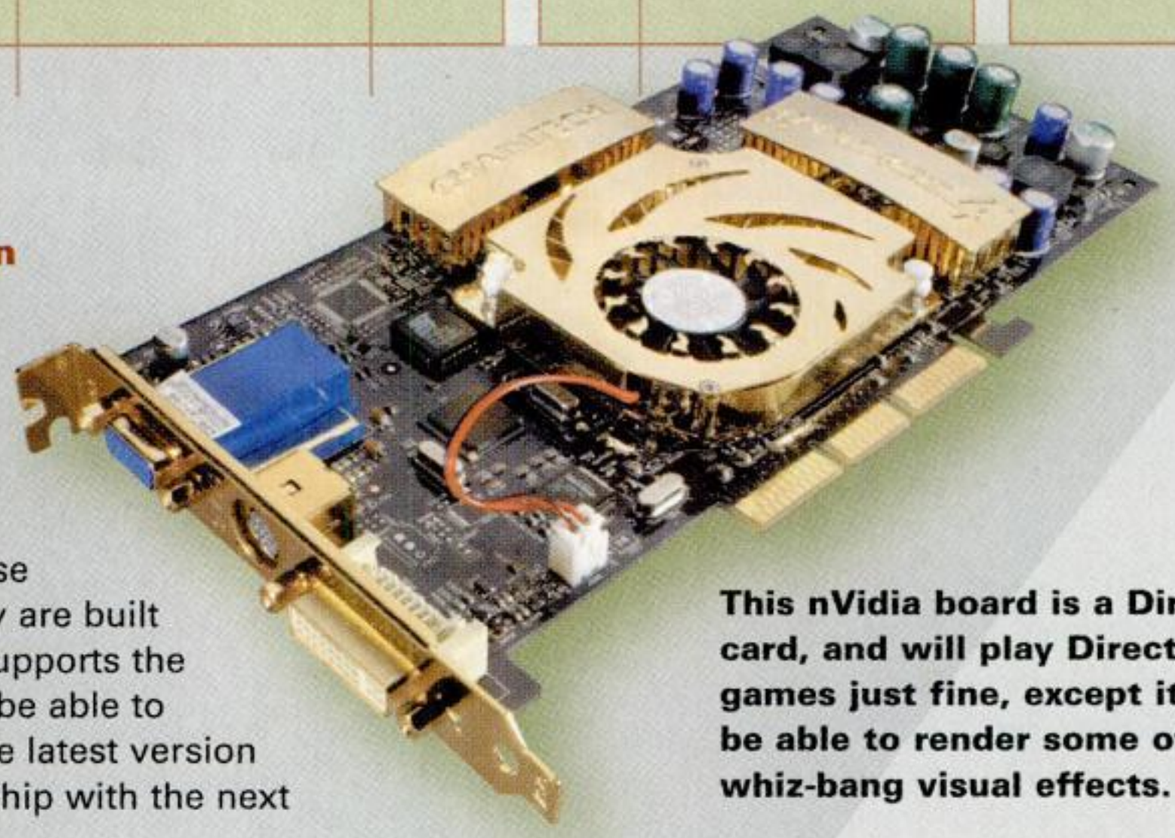
Question: What is the key difference between different versions of DirectX?

A: Microsoft's DirectX is a programming language game developers use to create 3D scenes and special effects in games. As such, videocard manufacturers create hardware support in their products for these effects. As new specifications for DirectX come out, they are built into videocards. Therefore, a DirectX 8 videocard only supports the effects included in that revision of DirectX, and will not be able to render the effects included in DirectX 9, for example. The latest version of DirectX is 9.0b, but it's expected that version 10 will ship with the next version of Windows.



This nVidia board is a DirectX 8 card, and will play DirectX 9 games just fine, except it won't be able to render some of the whiz-bang visual effects.

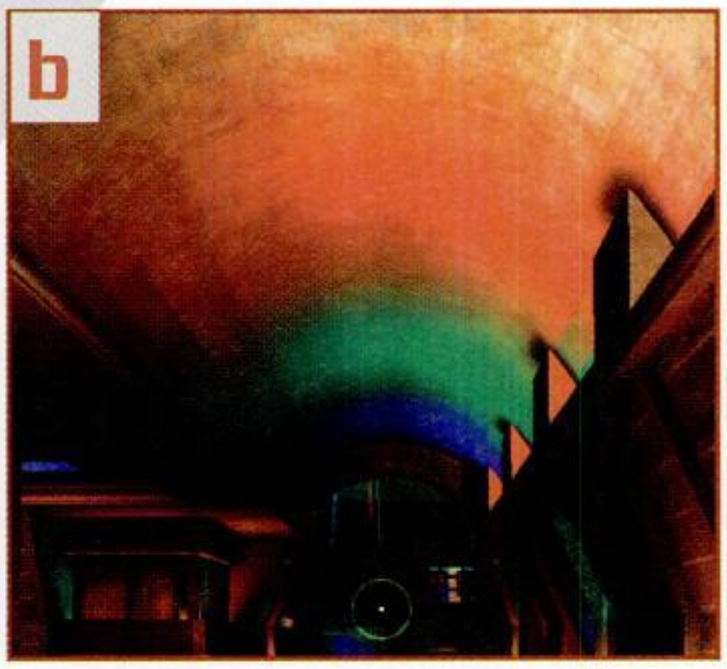
Question: What's the difference between bilinear, trilinear, and anisio filtering?

A: Each filtering strategy is designed to make the bit-map textures stretched over polygons look more realistic. Simply put, if 3D objects and environments weren't filtered, they'd look pixelated and jaggy, and no one would be very impressed by 3D games. But filtering strategies also have a particularly important relationship to mip-maps.

Mip-maps are sets of different textures of varying quality. For example, when you stand stationary in a 3D scene, the textures stretched over objects in the background are low-res, low-quality mipmaps, and the textures stretched over objects in the foreground are high-res, high-quality mipmaps. As you walk forward in the scene and begin to get closer to the previously far-away objects in the background, those objects' low-res mipmaps automatically swap out for higher-res versions. This rendering strategy is helpful to frame rates because low-res, low-quality textures demand less memory bandwidth than higher-quality textures. But here's the rub: The demarcation lines between mipmap levels of varying quality can be visually distracting if they're not adequately filtered.

To give you a better idea of how the different filtering modes affect mipmaps in 3D games, we fired up *Quake III*, and set it to show different mipmaps in "false colors" (the command is "r_colormiplevels 1" if you want to try for yourself). In the pictures you see below, each mip level appears as a different color. The first level represents the highest texture quality and

has normal color. In the images below, the second mip level (of slightly lesser quality) is red, and then the levels are green, then blue, and then back to red again, accordingly. We'll show you the effect different filtering types have on the transitions between different mipmap levels so you can judge what to enable for yourself.



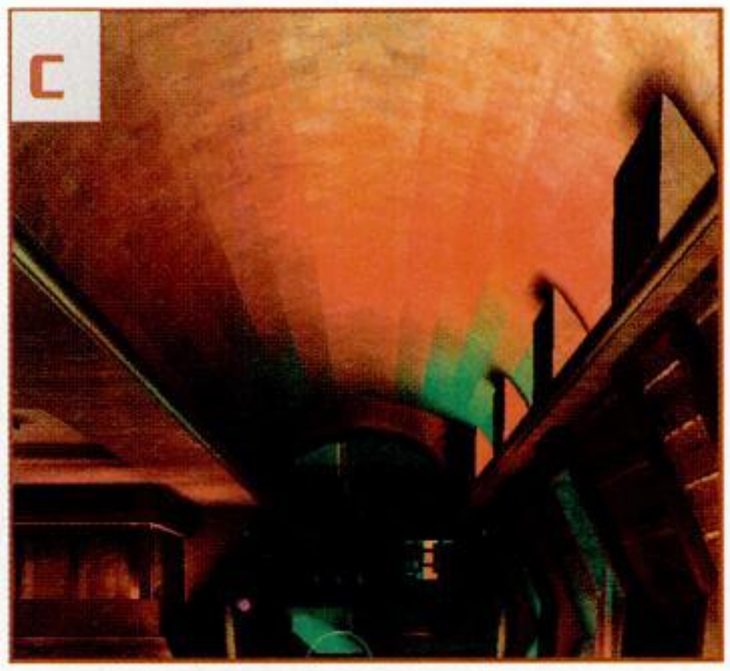


Image A shows only bilinear filtering. Notice that seams between textures are smoothly blended, but there's no blending between different mipmap levels. In image B, trilinear filtering is enabled. Note that the transitions between mipmap levels are smoothly blended, which will eliminate the visible seams between mipmaps. Image C shows you the same scene with anisotropic and trilinear filtering are enabled. With aniso on, the mipmaps are perspective-corrected, which creates the stair-stepping effect you see as you look from the sides to the top of the arch.

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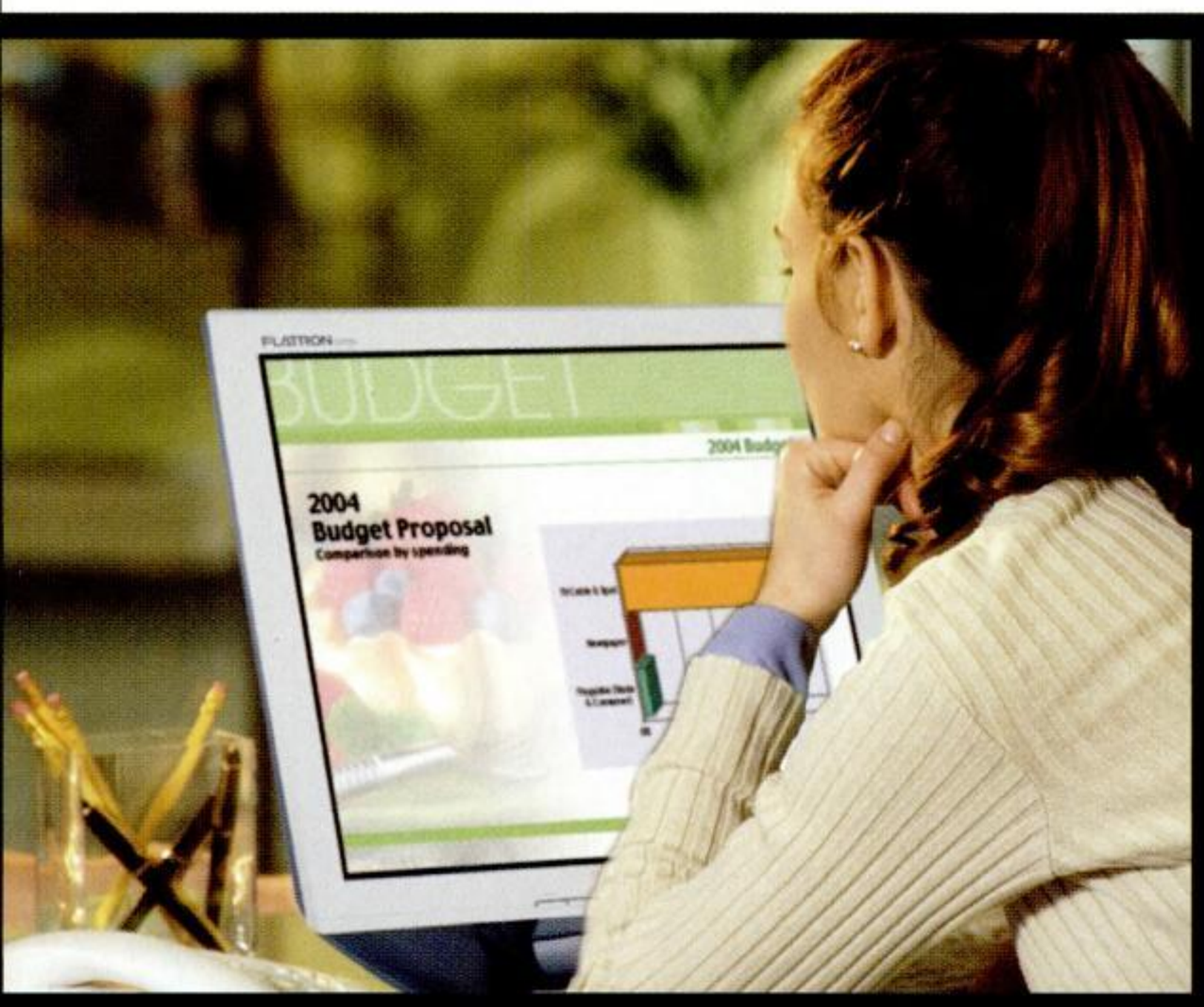

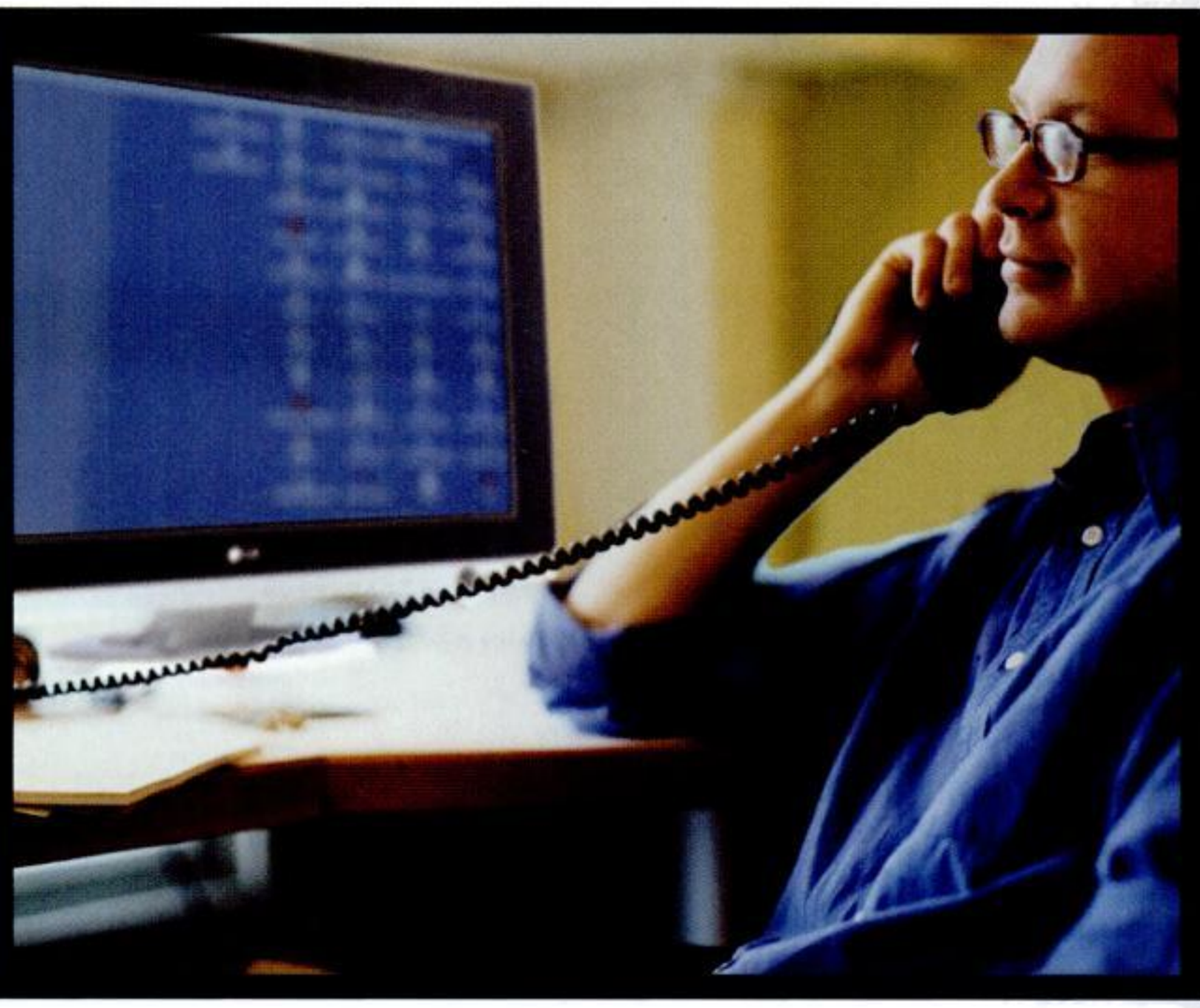

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LIFE'S GOOD

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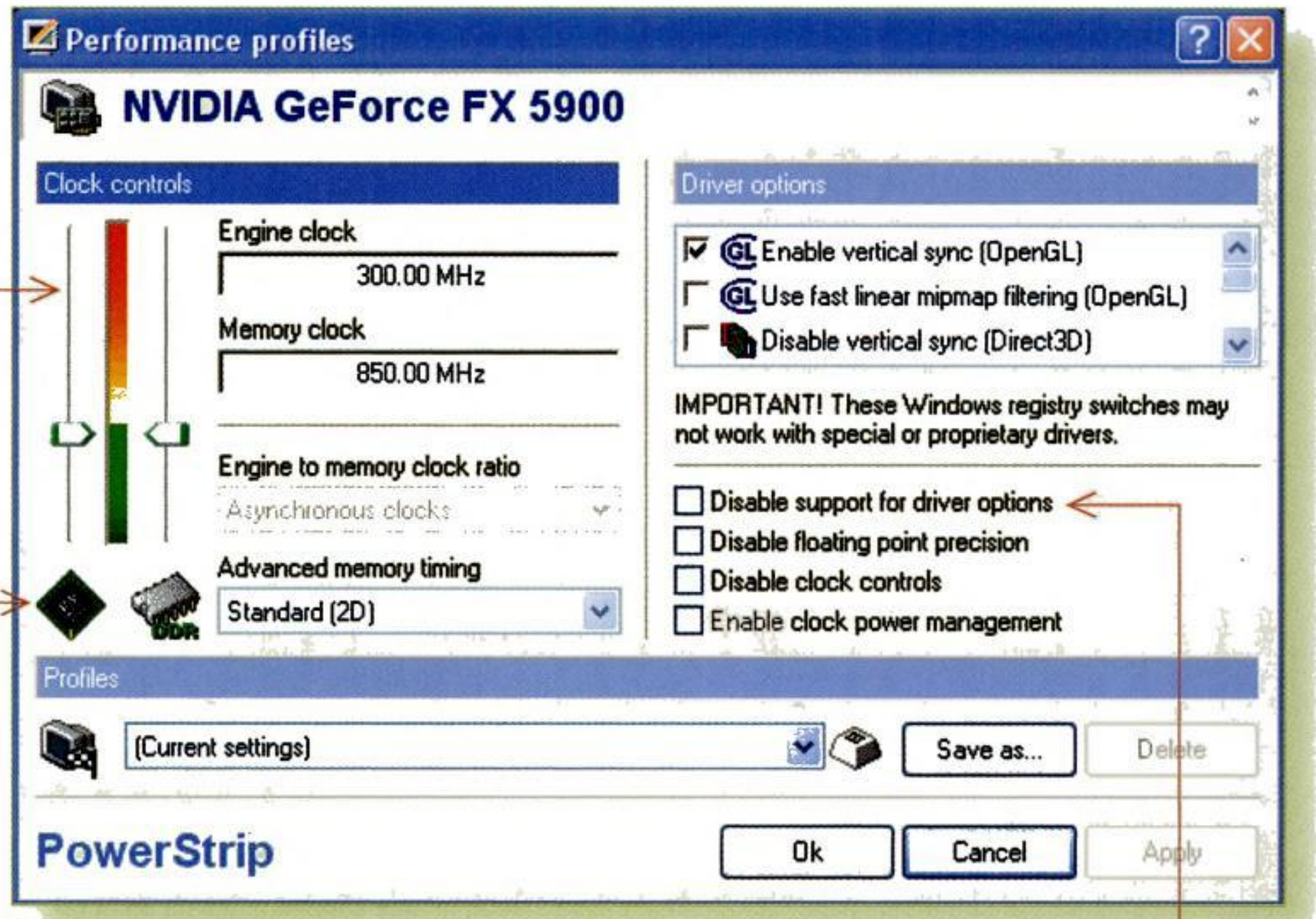
MAKE USE OF *POWERSTRIP'S* 7 Coolest Features

PowerStrip (on the included CD) **is a powerful utility you can use to unlock much of your videocard's hidden potential. In this how-to, we'll walk you through its 7 coolest features.**



#1: Overclocking

If you have one of the new generations of videocards that include overclocking utilities, you may want to use the clock controls supplied with the display driver. For practically everything else produced since 1995, you'll find clock controls here: **PowerStrip menu > Performance profiles > Configure.** You can control multiple graphics cards from this screen, and—if the hardware design permits—set engine and memory clocks independently; then save different speeds to various profiles and invoke them at the touch of a hotkey. Go easy on these controls and use common sense. If your card could run stably at a much higher speed and under all conditions, the manufacturer would have shipped it that way to begin with. Start by increasing the engine clock just 5MHz at a time, and then test each increase extensively for stability using your favorite games. When you reach the limit, back off 5MHz or 10MHz to provide a safety margin. Once you've discovered the limit for the graphics engine, leave it there and repeat the same procedure with the memory clock, watching closely for early, visible signs of pixel corruption and garbage. Note that the video BIOS will restore the manufacturer's defaults each time it initializes. You don't have to have *PowerStrip* running all the time, but you do need to run it after Windows loads in order to override the manufacturer's defaults and restore your own clock preferences.

#2: Raising the limits

The first time *PowerStrip* meets up with your graphics card, it records the current detected clock speeds as your defaults, then calculates a reasonable range based on those values. Typically, the max is set to 133 percent of the default and the minimum is set to 80 percent. So if your card runs by default at 300MHz, *PowerStrip* probably will offer up a range of between 250MHz and 400MHz. If you need to go higher—or, heaven forbid, lower!—than those numbers, double-click on the icon immediately below the clock slider(s), then enter the multiplier of your choice. Just remember that increasing the multiplier will not in itself make your card faster. It just allows you to experiment with higher speeds.

#3: Eye candy

While you are still on the **Performance** page in *PowerStrip*, uncheck the option to "Disable support for driver options" and have a look at the list of switches in the box above. If you want to disable vertical sync or set antialiasing and/or anisotropic filtering to their highest levels while you play, then a *PowerStrip* Performance profile may be just the ticket. But keep in mind that, unlike the clocks (which can be changed anytime), these switches have to be set *before* you load a game.

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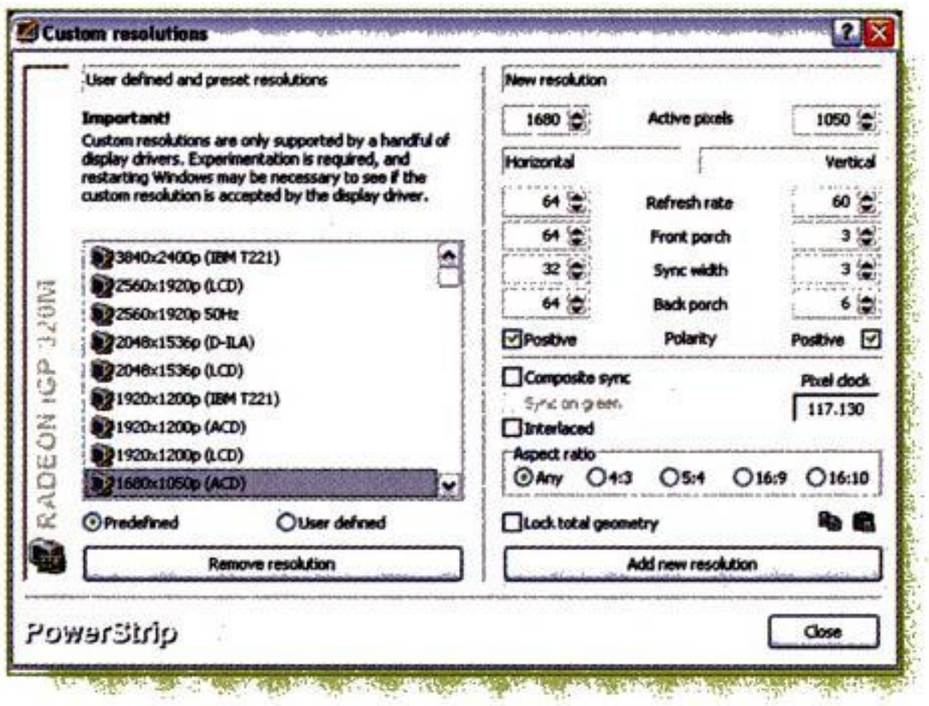
#4: Using profiles

Most people leave their videocards overclocked at all times, mainly because it's a pain in the butt to keep switching the clock and memory speeds back and forth. Luckily, *PowerStrip*'s Application profiles make it easy to customize your card settings for different circumstances. Create a couple of overclocked Performance profiles—one named, say, "Max visual quality" with all the eye candy enabled, and another named "Pure speed" with v-sync off and the eye candy disabled. Then go here: **PowerStrip menu > Application profiles > Configure**. Create a profile for your game or benchmark and assign the appropriate Performance profile to it. Then start the game or benchmark from the *PowerStrip* menu instead of the Windows Start menu. *PowerStrip* will change the clocks, turn on/off the eye candy, and then launch the game or benchmark. When you're finished, *PowerStrip* will automatically restore everything to the way it was *before* you clicked on the Application profile.

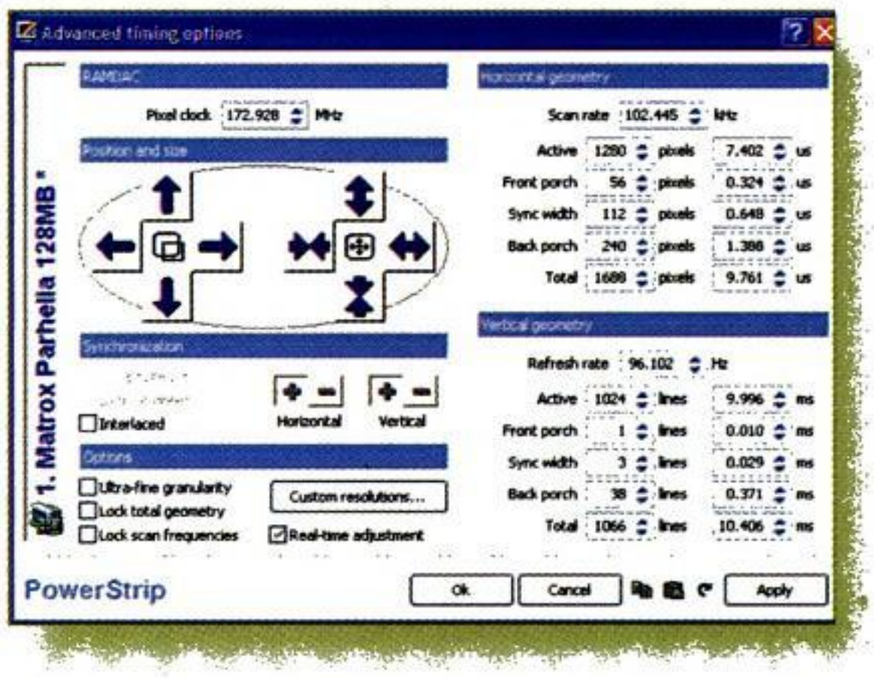
#5: Custom resolutions

Graphics cards are capable of generating practically any resolution, but Windows display drivers usually include only the most commonly used. Fortunately, the latest display drivers from ATI, Matrox, and Nvidia can accept a wide range of custom resolutions, which you can define in *PowerStrip* here: **PowerStrip menu > Display profiles > Configure > Advanced timing options > Custom resolutions**. You also can specify your own custom resolution!



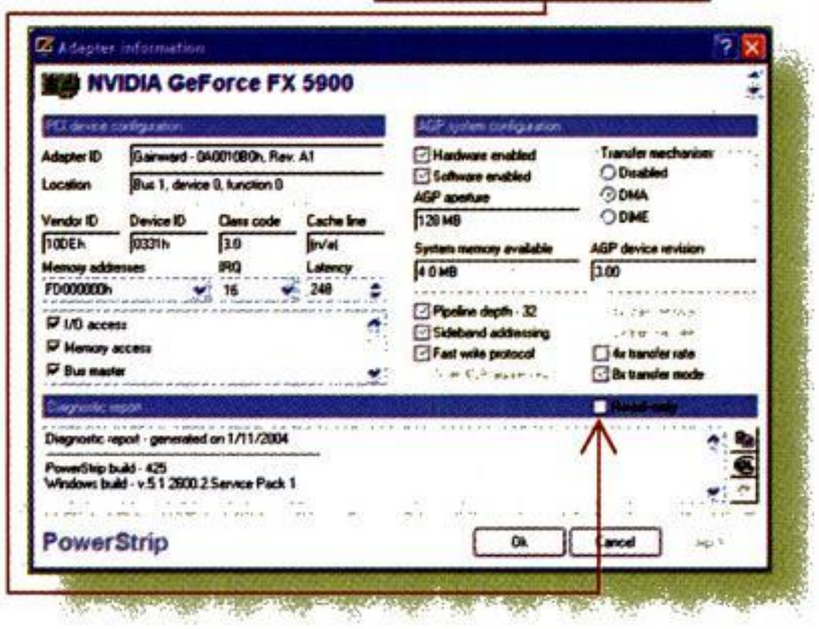
#6: Locking refresh rates

When gamers made the transition from the old Win9x/Me platform to NT/2000/XP, they discovered that games that changed resolution without specifying a refresh rate usually ended up running at just 60Hz. There are ways to "force" the refresh rate through the registry and driver, but nothing comes close to the power and precision of *PowerStrip's* geometry controls, which can be found here: **PowerStrip menu > Display profiles > Configure > Advanced timing options**. Not everyone likes being handicapped at 60 frames per second in a 3D game, so to sidestep this you only need to adjust the vertical refresh rate control to the desired value.



#7: PCI/AGP configuration

Graphics cards can sometimes be too aggressive in holding the bus, causing problems for other bus-master PCI devices, most notably PCI sound cards. *PowerStrip* offers a way to fix this here: **PowerStrip menu > Options > Adapter information**. Note the Read-only checkbox directly below the AGP transfer rates. When you uncheck this option, you will have access to two controls in particular that may assist in resolving compatibility problems. If the videocard's latency value is set to a very high value, like 248 clocks, reducing it to a more cooperative 80 clocks or even 64 clocks can significantly reduce any audio stuttering you may be experiencing. For those experiencing frequent crashes during 3D rendering, reducing the AGP transfer rate from 8x to 4x, or from 4x to 2x, can sometimes improve stability at only a small cost to performance.



Final thoughts

You can snag the latest version of *PowerStrip* from the CD included with this magazine, but don't forget to check for updates as you continue to use it in the future. Connect to the Internet and go to PowerStrip menu > Options > Online services > Live update.

Ask the Doctor

Your PC is sick, we've got the cure

WORST-CASE SCENARIO

What is the worst possible outcome of a failed attempt at videocard overclocking? How likely is a "failure" when attempting this?

The worst outcome is that your board will simply stop working, which could be a big deal or a little deal depending on its value. However, catastrophe can largely be avoided simply by overclocking in very small increments. For example, try increasing your board's memory or clock speed in 5MHz increments. After each bump up, play a 3D game for a while and watch for signs of excessive heat, such as graphical artifacts and other anomalies. Once you start seeing weirdness in your games or your PC's behavior, back the clock speed down a notch and you should be just fine. Just remember—overclocking your videocard could shorten the card's overall lifespan.

ARE ONBOARD GRAPHICS REALLY THAT BAD?

Are integrated graphics any good? Will they be able to run *Doom 3*?

Integrated graphics—that is, graphics that are built directly into a motherboard—are designed to provide minimal 3D performance in exchange for reduced cost. Integrated chips are not designed for gaming, but rather for simple 2D desktop work. As such, anyone serious about gaming should never consider using integrated graphics.

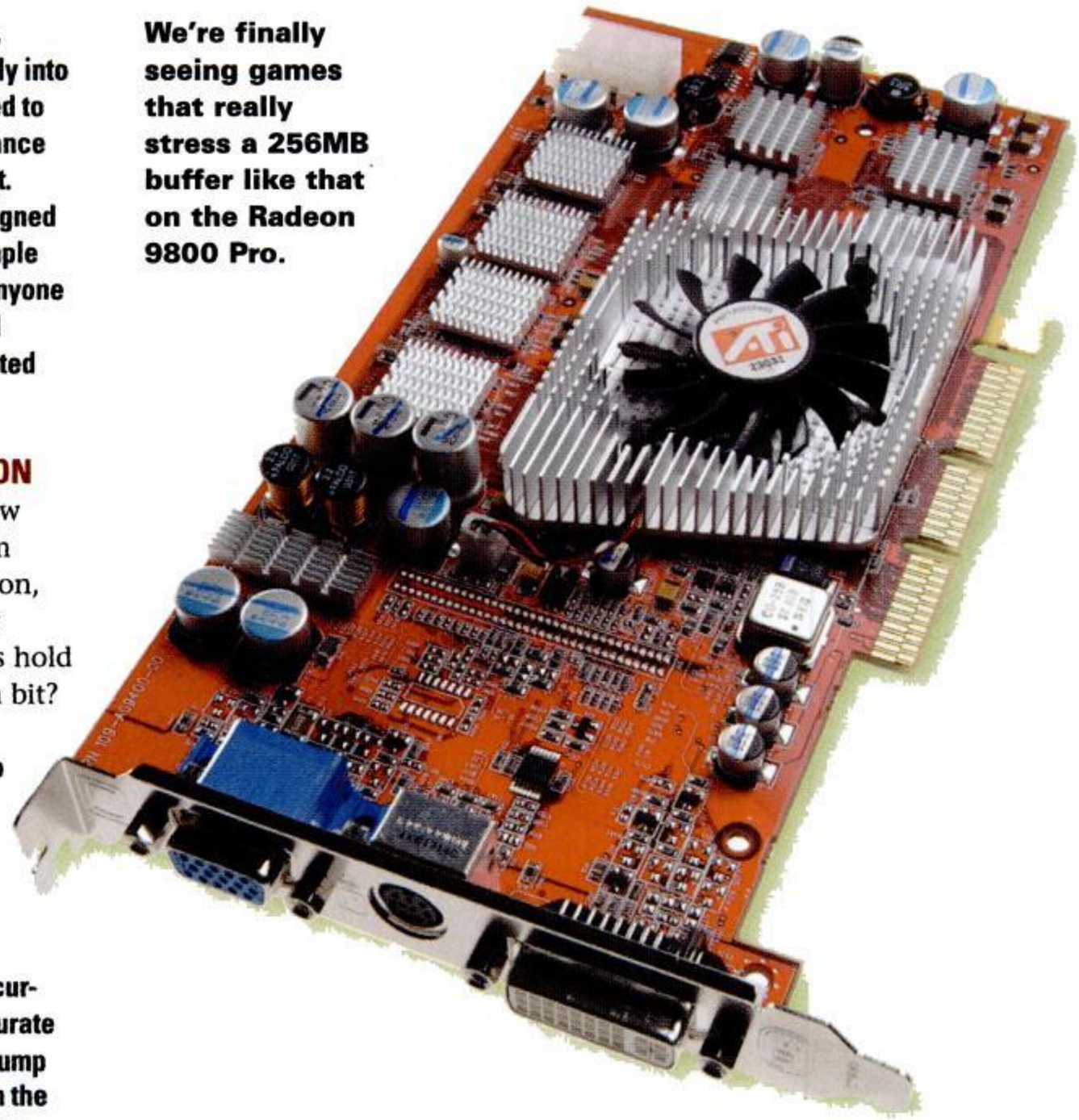
VEXED BY AGP 8X RADEON

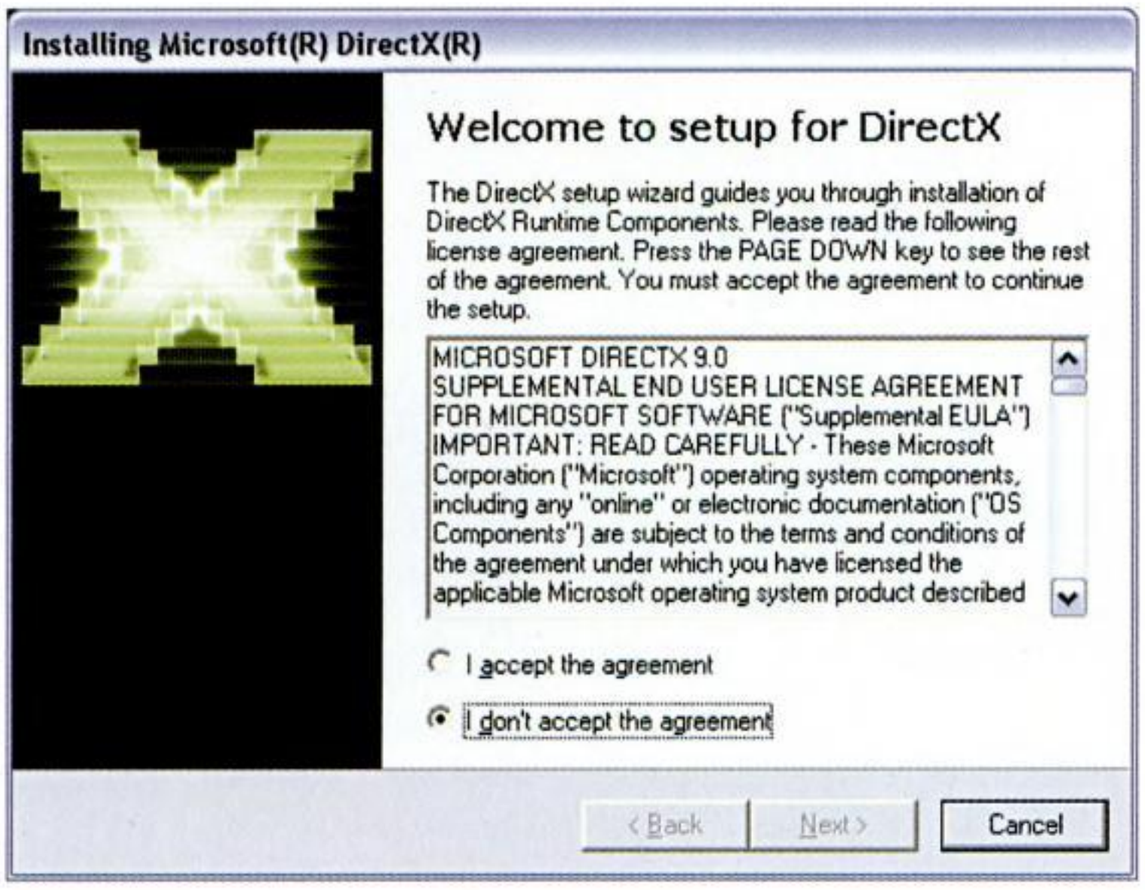
I'm in the market for a new videocard and the card I'm looking at is AGP 8x Radeon, but my motherboard only supports AGP 4x. Will this hold my videocard back quite a bit?

Do you need an AGP 8x mobo to get the max performance from the Radeon? Yes. Do you need an AGP 8x mobo to get the max performance from today's games? Not really. You see, current games aren't able to saturate the AGP 4x bus, which can pump about 1.06GB/sec of info from the videocard to main memory. Our testing backs this up.

We tested the Radeon 9800 Pro in a board that allowed us to disable AGP 8x. And, as far as our benchmarks go, there was no significant difference between 8x mode and 4x mode. We do expect to see games this year that will stress the 4x AGP bus.

We're finally seeing games that really stress a 256MB buffer like that on the Radeon 9800 Pro.





You should always keep both your videocard drivers and your version of DirectX up to date, as newer versions typically offer increased performance and stability.

NEW DIRECTX WITH AN OLD CARD

Is it ok to install DirectX 9 on my system if I only have a DirectX 8 videocard?

Yes, it is ok, and it's also a good rule of thumb to make sure you always have the latest version of DirectX as well. All games require a certain version to run, so if you haven't updated your DirectX installation in a while and want to play a brand-new game, you could have problems. Usually, games that require an upgrade to a new version of DirectX will include it in the installation, but not always, so be sure to check.

IS 256 JUST FOR KICKS?

Do I really need a videocard with 256MB of onboard memory for today's games?

As we write this in early 2004, you don't need a 256MB card, since there are a few games on the market that can actually fill such a massive frame buffer. With *Half-Life 2* and *Doom 3* on the horizon, you're going to need that extra memory eventually, so if you're upgrading now, it's a good idea to get a 256MB card to ensure its usefulness into 2005 and beyond.

TOWERS OF POWER

What are those brown cylindrical towers all over my videocard?

Those are capacitors, and their job is to make sure the GPU always receives a steady stream of power from the power supply without any major spikes or dips. You should be

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extremely careful when handling your videocard, since the capacitors are only attached at their base and can snap off quite easily.

NEED MORE FUNKY FLOW

I need to know how to upgrade the fan on my videocard. I need more cooling for my videocard, and this seems like the only way, since the fan is glued on and the connector cables are soldered to the card.

You usually cannot remove the heatsink/fan that is included with your videocard, since it is usually glued to the chip with some alien substance that does not want to come off. However, we've heard of people who have had success putting the card in the freezer, and then, once frozen, popping the heatsink right off. We haven't personally tried it, though, and applying any kind of force to your GPU could cause permanent damage.

If your fan's wires are soldered to the board, you need to first remove the solder using either a wick or a solder sucker, then reattach the new fan to the same leads. (Just pulling them could cause permanent damage to your board.) If this level of hardware-hacking sounds scary, you can always install a PCI fan in the slot directly below your videocard for more cooling. You also should make sure there is a case fan directly above the AGP slot blowing warm air out of the case. You can mount a fan on the case door as well, so that when it's closed, the fan is blowing directly onto the PCI slots. Some cases even include these fans, but most require drilling a hole to mount them.

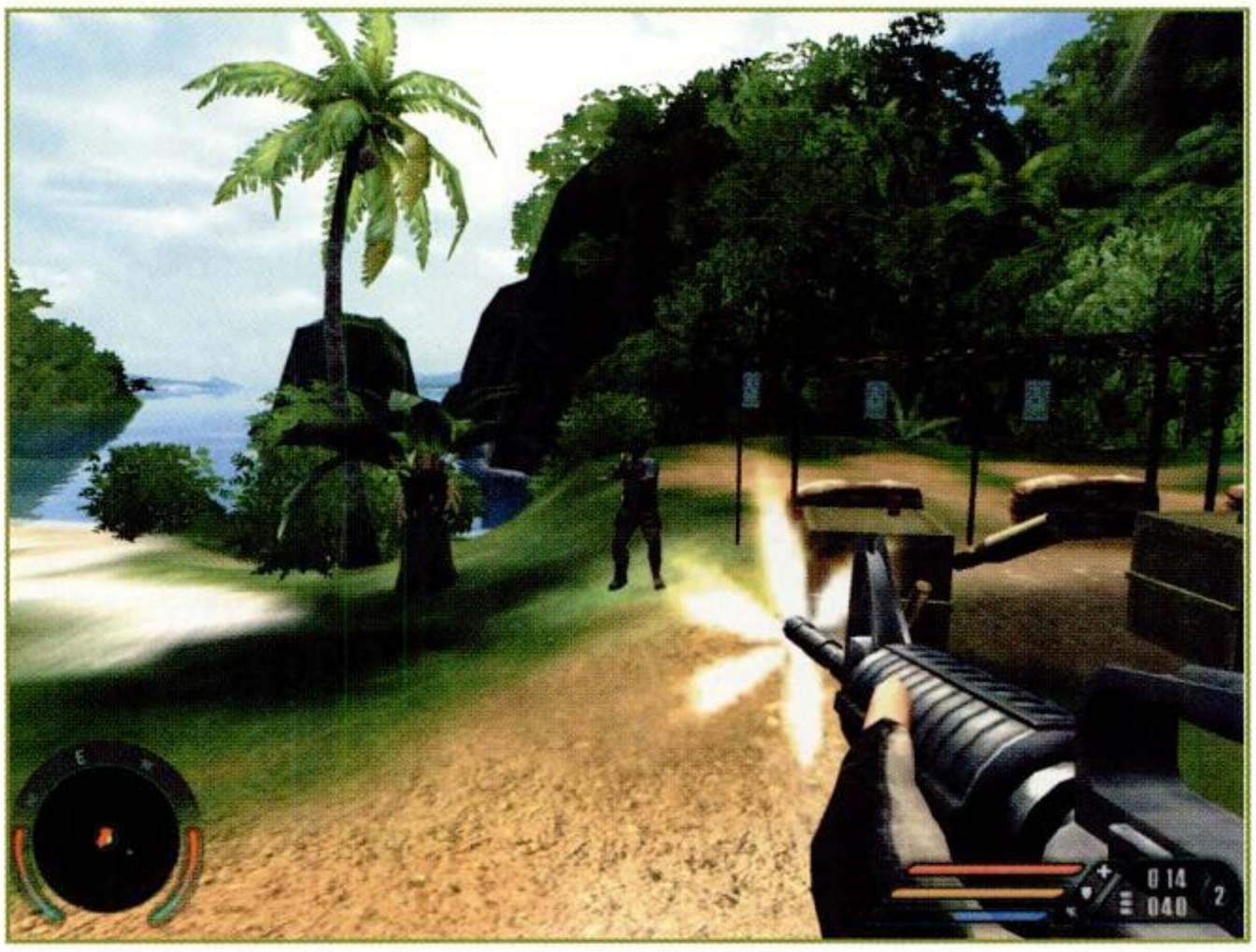
Today's high-end videocards all include heatsinks on top of the GPU that are difficult, if not dangerous, to remove. Dangerous to the card, that is.

CRASH COURSE

I'm experiencing random crashes in games. What's my basic troubleshooting strategy?

First, if you're overclocking anything in your system, stop. Even slight overclocking can cause instability. If that doesn't fix your problem, then go to your motherboard or system vendor's web site, and get their latest motherboard chipset drivers (do not confuse chipset drivers with a BIOS update). Install the chipset drivers, making sure you reboot as prompted. Now install the latest videocard drivers appropriate to your videocard—most likely from ATI.com or nVidia.com. Updating these two drivers in this order will fix 90 percent of all crashes in games.

If you still have problems, you should open your PC and make sure that you've got good airflow around the videocard, and that its onboard fan is working properly. You should also ensure that your finicky game doesn't have known issues with your 3D accelerator by checking the game's support page (the URL is usually listed in the game manual). Finally, don't rule out other components, such as your network card or soundcard. Again, check the game's support site for known issues.



Upcoming games like *Far Cry* will bring most older videocards to their knees. If you can't afford to upgrade, you'll have to turn down the eye candy.

TIME TO UPGRADE

I get errors when I try to play some new games, but my computer meets all the games' system requirements. What's wrong?

The system requirements listed on the side of game boxes aren't always accurate. Frequently, a game will state that it requires a 32MB 3D accelerator, but what that really means is that you need a 3D accelerator with hardware T&L. For the record, all the GeForce and Radeon lines include hardware T&L. As we move forward, games are beginning to require programmable shaders support too, so eventually you're just going to have to upgrade just to play newer games—it's unavoidable!

A SWEET TOOTH FOR EYE CANDY

I'm running my favorite game with all its effects turned to the max—and it's dog slow. What's your opinion on which visual settings should be set to the max whenever possible, and which settings I should sacrifice, and in which order they should be sacrificed?

The easiest way to increase frame rates is to lower your resolution. For example, at 1600x1200, the minimum number of pixels that your 3D card will draw per frame is 1.92 million. And, if you enable antialiasing, texture filtering, and other features, your card will draw considerably more than that. In contrast, at 640x480 the minimum number of pixels the card draws is about 307,200. Even at 1024x768, the card draws only about 800,000 pixels. The upshot is that lowering your resolution might even allow you to run all the fancy visual effects at full blast.

If running at low resolutions is anathema to you, try disabling antialiasing and anisotropic filtering. Both of those features are performance hogs. Decreasing texture quality and turning down the number of mip-map levels can further increase performance, but they will also severely impact your image quality.

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Q What makes a hard drive "fast"?

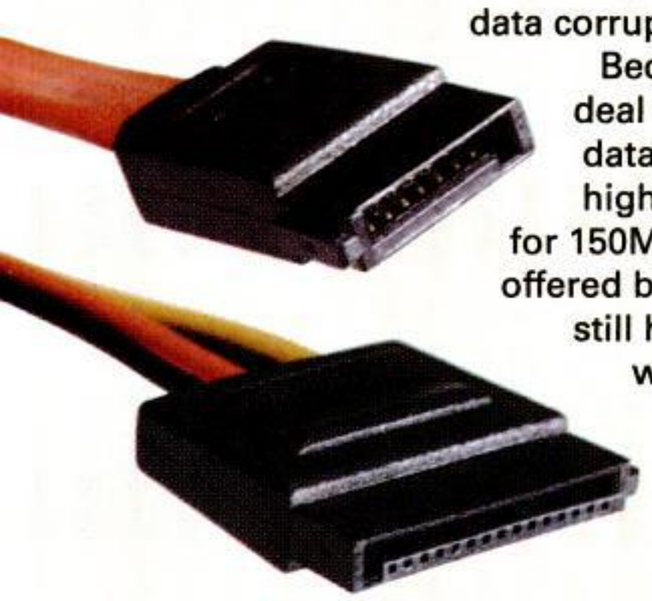
Many factors define a hard drive's raw speed potential, but the most important is the rotational speed of its platters. All drives store their data on internal platters, and the data is retrieved when the platters spin under read/write heads. The faster these little platters spin, the faster the data can be accessed. Today's standard desktop drives rotate at 7200rpm, and these drives are very fast. There is also a handful of 10,000rpm drives, which are insanely fast due to their rotational-speed advantage. On the server side of things, where performance is king and money is no object, 15,000rpm drives reign supreme. These drives are the absolute pinnacle of performance, but not practical for desktop tasks due to their high cost and relatively small capacity.

The size of a drive's onboard memory plays a distinct role in its overall performance as well, with the rule of thumb being "the bigger the better." Onboard memory buffers range in size from 2MB to 8MB, and drives with these large buffers deliver up to 30 percent faster performance, on average, than drives with smaller buffers. Typically, data is delivered from the buffer as fast as the interface allows, so the more data a drive can wedge into its buffer, the faster it can perform typical desktop tasks.

Q What is Serial ATA?

Take a look at a machine equipped with Serial ATA, and the most striking feature will be the skinny data cables. While skinny cables have a positive impact on a case's internal airflow, this isn't the main reason why the PC industry is dropping parallel ATA (and its flat, wide cables) for SATA. The main reason is that the current parallel interface is facing a performance wall.

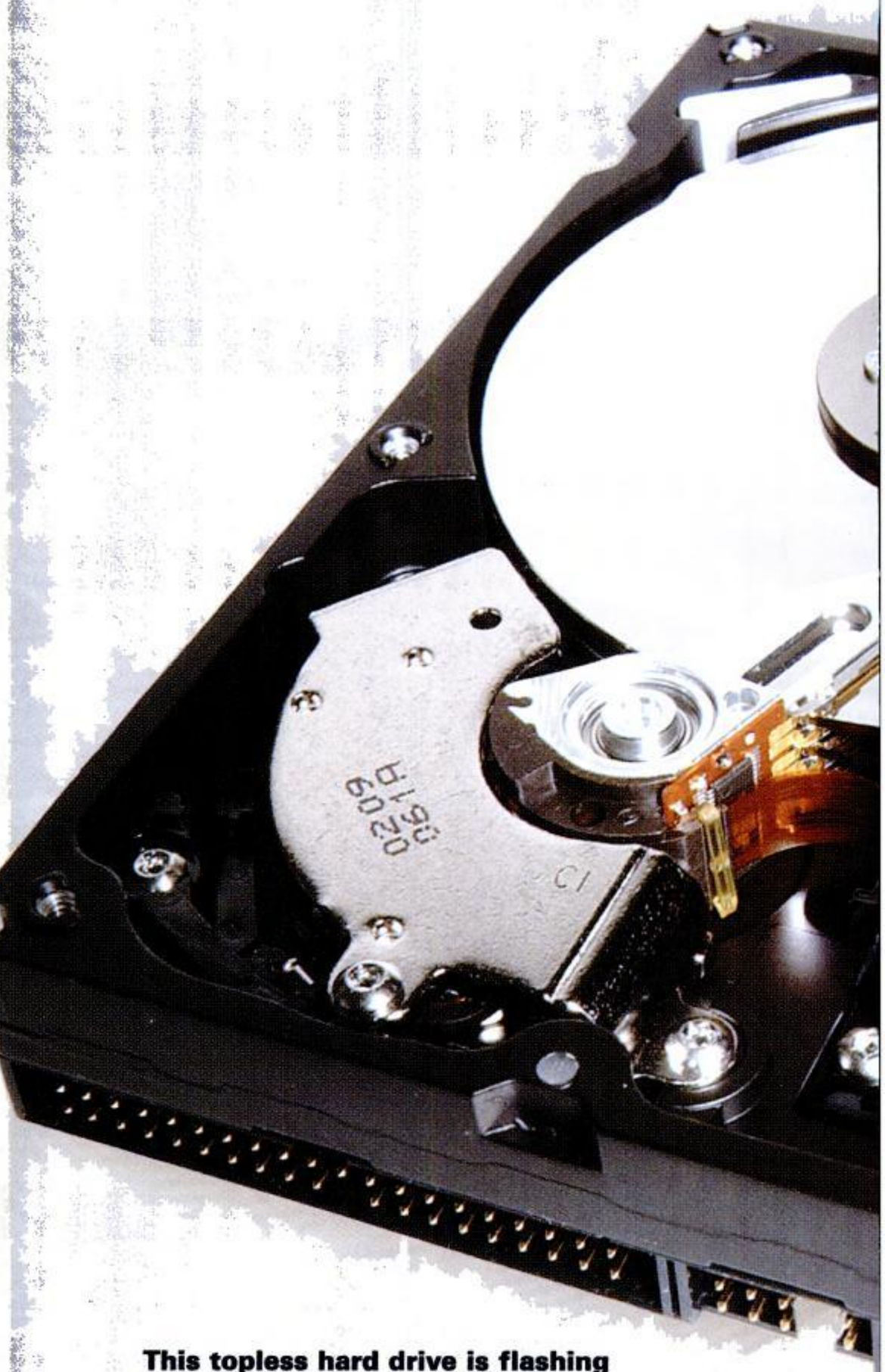
Parallel ATA cables send data along multiple wires within the same wide ribbon. Each piece of data must travel along the length of the familiar ribbon cable, and arrive at the same time in order to maintain data integrity. In order to get more speed from this scheme, the only option is to push the data to higher frequencies or make the data path wider. That's where the problems lie. Making the data path wider is impractical, as there are already 80 conductors in the ribbon. And increasing speed adds to the likelihood of data corruption.



Serial ATA drives have separate cables for data (above) and for power (below).

Because serial interfaces don't have to deal with coordinating multiple lanes of data, we're able to push them to much higher speeds. SATA is currently rated for 150MB/s, slightly higher than the 133MB/s offered by the fastest parallel ATA spec (which still hasn't been widely adopted). SATA will eventually double to 300MB/s in 2004, and then again to 600MB/s by 2007.

Although current hard drive transfer rates fall far short of the maximum throughput of even parallel ATA specs, companies are laying the foundation for the future. You don't, after all, wait for the traffic jam before you try to build the roads (unless you run the state of California).



This topless hard drive is flashing its platters like it's Mardi Gras. The silver arm over the platters is the read/write head.

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HARD DRIVES

Every PC needs a hard drive, but the options are mind-boggling. Follow along as we unboggle them for you.

The hard drive is truly the unsung hero of PC components. You know the type; the kind of component that labors away in the background while all the flashy components like the CPU and videocard get all the credit. Yet the hard drive is the one single component that is used in almost every single task you'll ever perform on your PC.

Whether you are trying to access folders on your hard drive, surfing the web or copying content from one location to another, your hard drive is constantly in use. Even when you are just sitting in front of your computer, staring at the screen, the hard drive's platters are spinning furiously as the drive's read/writer heads eagerly await your next command. The millisecond you click on a folder, these heads leap into action to deliver the data you've requested, and as soon as they complete your request, they return back to their "ready and waiting" status. You could say the hard drive is the Labrador retriever of the PC, waiting patiently with its tongue hanging out and tail wagging as you decide what trick you'd like it to perform next. As soon as you toss the bone and say "fetch!" it's off and running. And the good news is, drives promise to become even faster over the next 12 months thanks to the emergence of an all-new hard drive interface named Serial ATA.

This new interface doesn't offer any *major* benefits over the old interface, which was called "parallel ATA," other than that it offers more bandwidth for future drives to take advantage of, and is easier to add to a system due to its smaller cables and lack of jumpers. Parallel ATA drives have to be correctly configured via jumper pins as Master or Slave prior to use, but the newer drives have no such limitation—just plug them in and they work. Nonetheless, eventually all hard drives will use the Serial ATA interface, so if you are in the market for a hard drive today, you'd be wise to consider a SATA drive in order to make your system as future-proof as possible. Plus, drive manufacturers are only releasing their top-of-the-line drives in SATA form these days, so if you buy one, you can be sure it's the cream of the crop (for now).

Tech Terms

All the specs and tech lingo explained

Areal Density
Areal Density, also called "Bit Density," is the amount of data that can be stored on a given surface area on a hard drive's platter. Increasing Areal Density is the most common method used by manufacturers to increase hard drive performance.

Burst Speed
Today's hard drives include onboard memory that is called a "buffer." When a piece of data is stored in this buffer and then requested by the operating system, it's delivered directly from the buffer, which is much faster than having the disk's mechanical apparatus retrieve the data. This process of delivering data from memory is called "bursting," and how fast a drive can deliver data from its buffer is its "burst speed," which typically is slightly slower than the maximum speed allowed by the interface.

Capacity
The storage capacity of a hard drive. Today, this is typically between 10 and 300 gigabytes (GB).

Data Transfer Rate
The average speed at which data can be transferred to and from a hard drive across a drive's entire capacity. A drive's data transfer rate is the single best specification to use in determining how "fast" a particular drive is.

Drive Head
These are tiny mechanical arms that float over a drive's platters and perform read/write operations. The tiny heads float just a few microns over the surface of the platter.

IDE
Integrated Drive Electronics. A hard drive that has its electronics integrated onto the drive itself, rather than requiring a separate plug-in card in order to function. For all practical purposes, IDE is ATA. While IDE refers to the interface architecture, ATA is the actual specification. This difference is lost to most users, however. An IDE port and ATA port refer to the same 40-pin connector on the motherboard.

ATA
Advanced Technology Attachment. This is the parallel interface used to attach hard drives, CD ROMs, and DVD drives to the majority of PCs on the market. The term "ATA" is used interchangeably with the term "IDE." Officially, there are the ATA-1 through ATA-6 specifications, which usually are written as 'ATA', and then the interface's maximum throughput. For example, the final spec of parallel ATA is ATA/133, which allows for data transfers of up to 133MB per second.

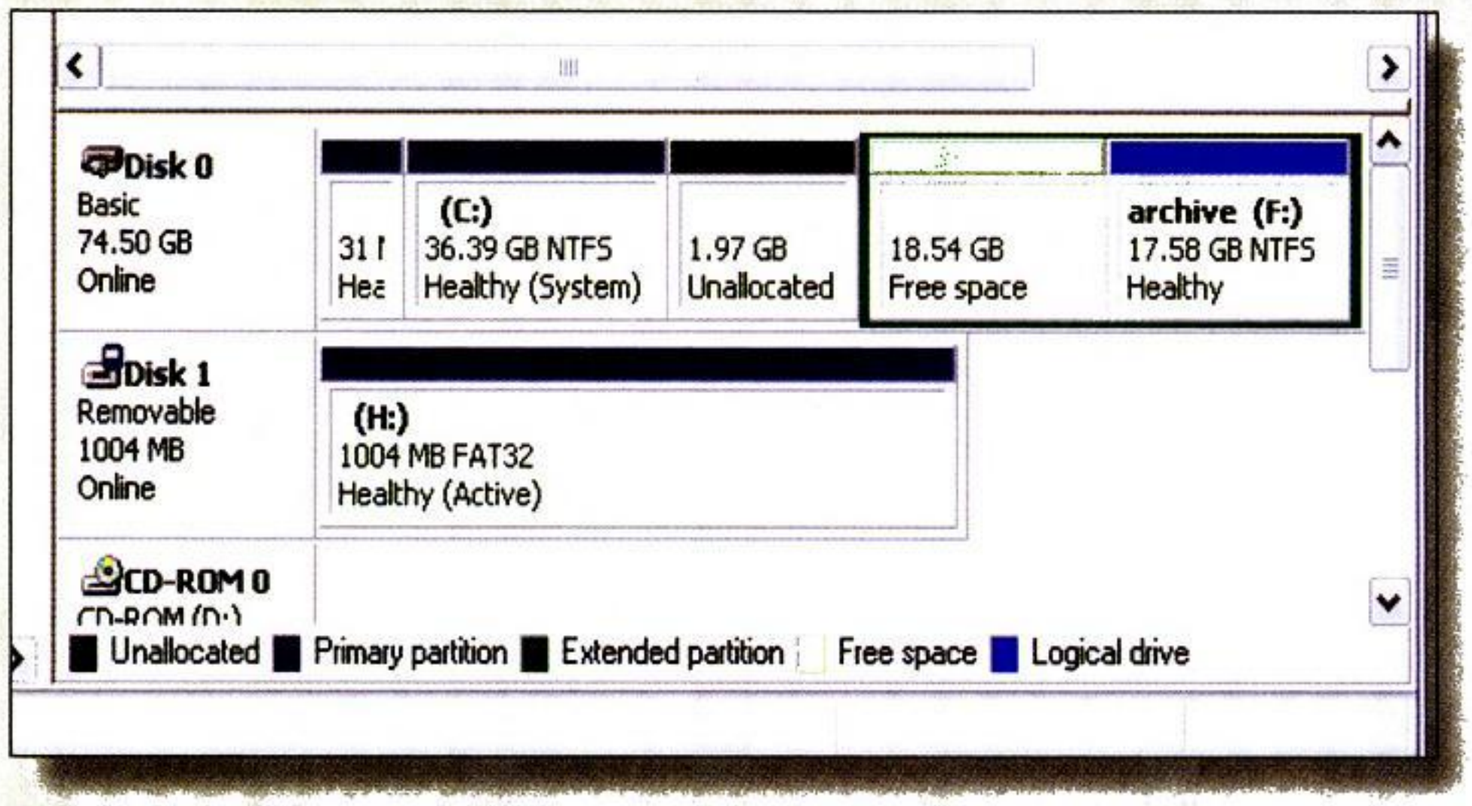
The de facto hard drive interface for the past several years has been this 40-pin cable dubbed ATA or IDE.

IDE Channel
This has been the primary channel for hard drives for many years now. An IDE channel (also called ATA) is a parallel interface with 40 pins that supports two drives per channel. A typical IDE controller found on a motherboard has two IDE channels and can support four devices.

Logic Board
The circuit board on the hard drive where the controller chip(s) and other electronic components are attached.

Master/Slave
A single IDE channel supports two devices, and each must be configured to be the Master or the Slave. Neither designation has any superiority over the other, but these designations are required in order for each device to be recognized on the channel.

Master Boot Record
This is the first sector(s) that a hard drive



This 75GB hard drive (Disk 0) has been sliced and diced into two partitions (C: and F:). Most people prefer to have two partitions on a drive: one for regular use and one for backup.

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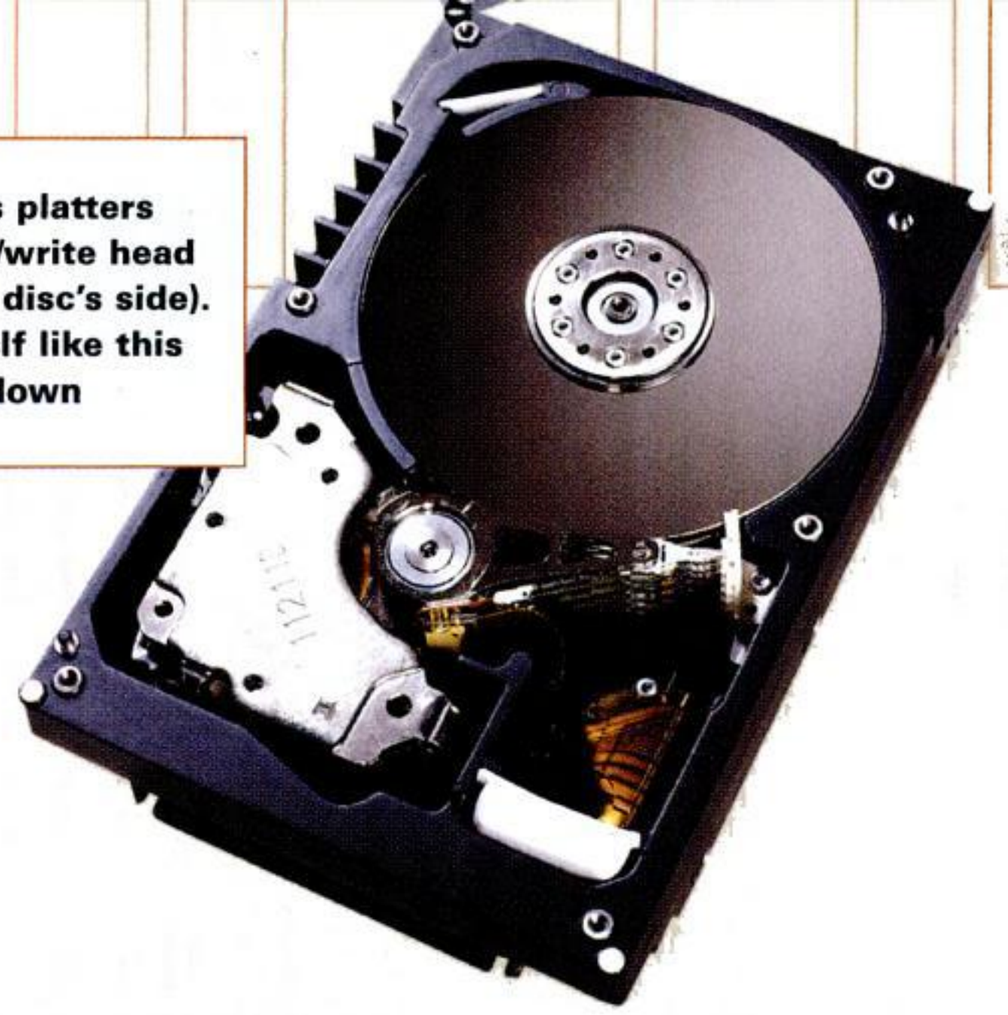

This Hitachi drive reveals its platters for all to see. Note the read/write head (the long arm parked to the disc's side). On some drives it parks iteslf like this when the drive is powered down

reads. It contains information on how the hard drive is formatted, how it is partitioned, and where an operating system can be located and loaded. Because it contains the partition table and its associated information, the Master Boot Record is sometimes called the "Partition Sector."

Onboard Memory

The memory included on a hard drive. This memory is used to store incoming data, and allows the drive to accept small amounts of data at a faster rate than it can actually write onto the disk. Since data can be transferred much faster from this memory than from the actually physical disk, hard drives with a large amount of onboard memory (8MB, for example) offer better performance than drives with less memory (typically, 2MB).

Partitions

A hard drive's capacity can be divided into multiple portions that are called "partitions." Each partition will appear as a separate disk to the operating system and user, but can be located on the same hard drive.

Platters

Metallic discs inside the hard drive where information is stored. The rigid nature of these discs gave rise to the name "hard drive" or "hard disk."

Read/Write Assembly

A hard drive typically has two read/write heads for each platter it contains. These are mounted near the tip of the access arms. The "whole enchilada" of the access arm and read/write head is called the "read/write assembly."

Random Access Speed

How fast a drive is able to locate a random piece of data, expressed in milliseconds. It includes the time it takes for the drive to locate the requested piece of data, move its read/write head to the proper location and then access the correct piece of data.

Rotational Speed

The speed at which the platters in a hard drive rotate. Rotational speeds of contemporary hard drives generally fall between 4,700 and 15,000 revolutions per minute (rpm). Higher rotational speeds typically yield higher performance at the expense of generating more heat and noise.

SCSI

Small Computers System Interface. A parallel interface that exists alongside the less expensive ATA interface. Up to seven or 14 devices can be connected on each SCSI channel. The interface also can be used to connect other high-bandwidth devices, such as scanners to the PC. Due to its high cost and ability to support a large number of drives, SCSI is primarily used in high-end server and RAID solutions.

The seven-pin Serial ATA connector plugs directly into the ports on the motherboard and drive, and doesn't require any jumpers to be set!

Serial ATA

Serial Advanced Technology Attachment. A new interface used for connecting drives to the computer. With seven pins instead of 40, Serial ATA cables are much slimmer than ATA cables. The first generation of Serial ATA interface is capable of a 150MB/s transfer speed, as opposed to 100MB/s for ATA/100.

Sector

The smallest unit on a drive that can be accessed. When a hard drive is formatted, it is divided into numerous concentric rings called "tracks," with each track being divided into numerous arcs called "sectors."

S.M.A.R.T.

Self-Monitoring Analysis and Reporting Technology. A feature built into hard drives that monitors and reports a drive's overall health, and also can let a user know if a drive is about to fail.

RAID

Redundant Array of Inexpensive Disks. An arrangement whereby more than one hard drive is combined to form a single storage volume. Depending on the configuration, better performance, better security, or both can be attained.

The only way to practically double a hard drive's speed is to add a second drive and divide up the work between them. It's a process called "R.A.I.D.," and here we see a four-drive array (the fifth drive is the primary volume).

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HARD DRIVES Cheat Sheet

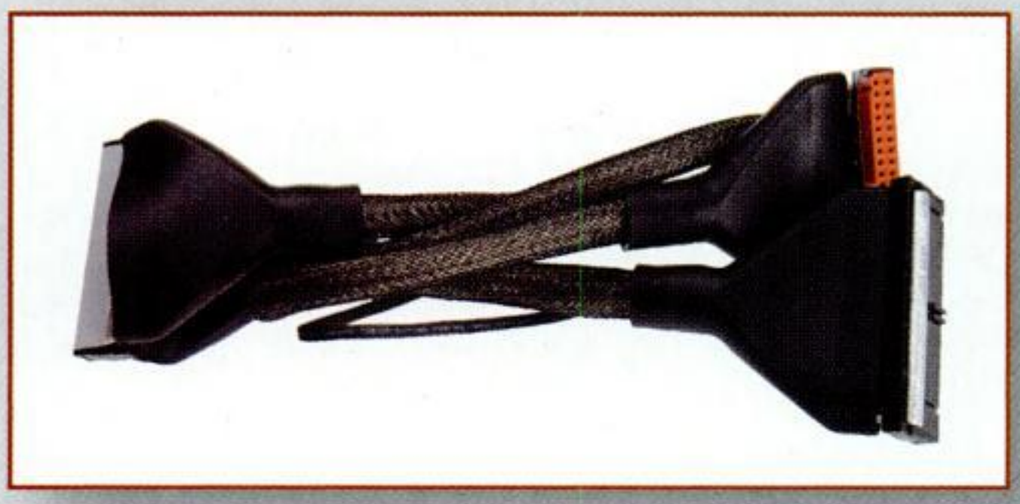
You've got questions, we've got answers

Question: What are the different rotational velocities offered in today's hard drives, and what are the benefits of each?

A: Today's desktop hard drives are offered in three rotational speeds. The slowest is 5,400 rpm, with these drives primarily being used for rudimentary storage duties where speed is of little importance. They are affordable since they represent last-gen technology and are not in high demand. The next fastest speed is 7200rpm, which is the norm for today's desktop drives.

These drives are very fast, and are more than adequate for all but the most demanding desktop users. Finally, for those "demanding" types, there are the 10,000rpm Raptor drives from Western Digital. These puppies are wicked-fast, and are zippier than 7200rpm drives by a wide margin. The only drawback to 10,000rpm drives is that they are only offered in 36GB or 74GB capacities, while 7200rpm drives are offered in capacities ranging from 120GB up to 250GB.

Western Digital Raptor drives spin at 10,000rpm and deliver stunning desktop performance.



Rounded IDE cables are easier to route than those big, flat IDE ribbon cables—and they also provide better airflow to boot.

Question: What are rounded IDE cables, what benefits do they offer, and are they safe?

A: Rounded cables are nothing more than a standard 40-pin parallel ATA cable in which the plastic liner between wires has been shredded to separate the wires. The now-loose wires are typically bound by zip ties, or are housed in plastic tubing or heat-shrink web. They're much easier to route than the big, flat ribbon cables, and the compacted wires help promote good airflow in a PC case.

Any downside to rounded cables comes from the fact that bundling those data lines so closely together can create electromagnetic interference above the tolerance of the drive or the controller, which can lead to slower operation as data is sent and re-sent, or in extreme cases, data loss. The best long-term solution to cabling issues is to switch to Serial ATA. SATA cables are substantially smaller and flatter than even the most tightly packed round IDE cable.

Question: What's a megabyte—1,000 bytes, or 1,024 bytes—and how does this question affect hard drive capacities?

A: Everybody who knows anything about computers knows that a kilobyte is 1024 bytes, a megabyte is 1024 x 1024 = 1048576 bytes, and a gigabyte is 1048576 x 1024 = 1073741824 bytes. Everybody, that is, except people who work in the marketing departments of hard drive manufacturers. You see, they claim that 1 KB = 1000 bytes, 1 MB = 1 million bytes, and 1 GB = 1 billion bytes. Hogwash. What this means is that the formatted capacity of your drives is at least 7 percent less than advertised—and usually this gap is even greater, because disk file systems need overhead to operate.

Voodoo Hard Drive Economics

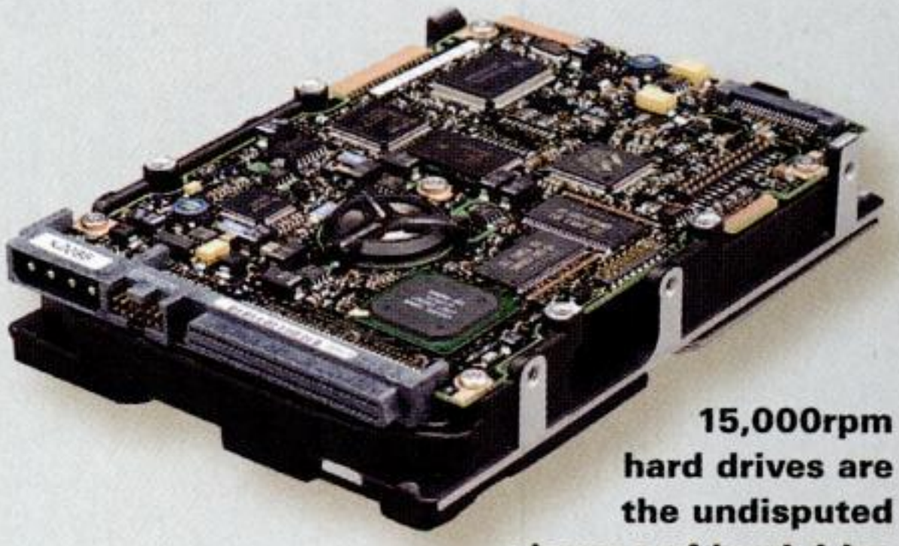
Advertised	Actual
10 GB	9.3 GB
50 GB	46.6 GB
200 GB	186.3 GB

Always remember to take approximately 7 percent off a drive's stated capacity to get the "real" capacity.

Question: Are SCSI hard drives still the fastest money can buy?

A: Yep. SCSI's quirky and expensive, but it's still where the big boys go for maximum performance. Virtually all 10,000 and 15,000 rpm drives are SCSI. Seek times are lower, reliability is higher, and the device chains can be much longer than they are with ATA.

Sure, ATA/133 and Serial ATA are fast. Yes, ATA RAID is a wonderful, low-cost, performance-enhancing invention. Still, it doesn't change the fact that SCSI's still top of the heap, king of the hill, look-at-me-ma-no-hands the best.



15,000rpm hard drives are the undisputed champs of hard-drive performance.

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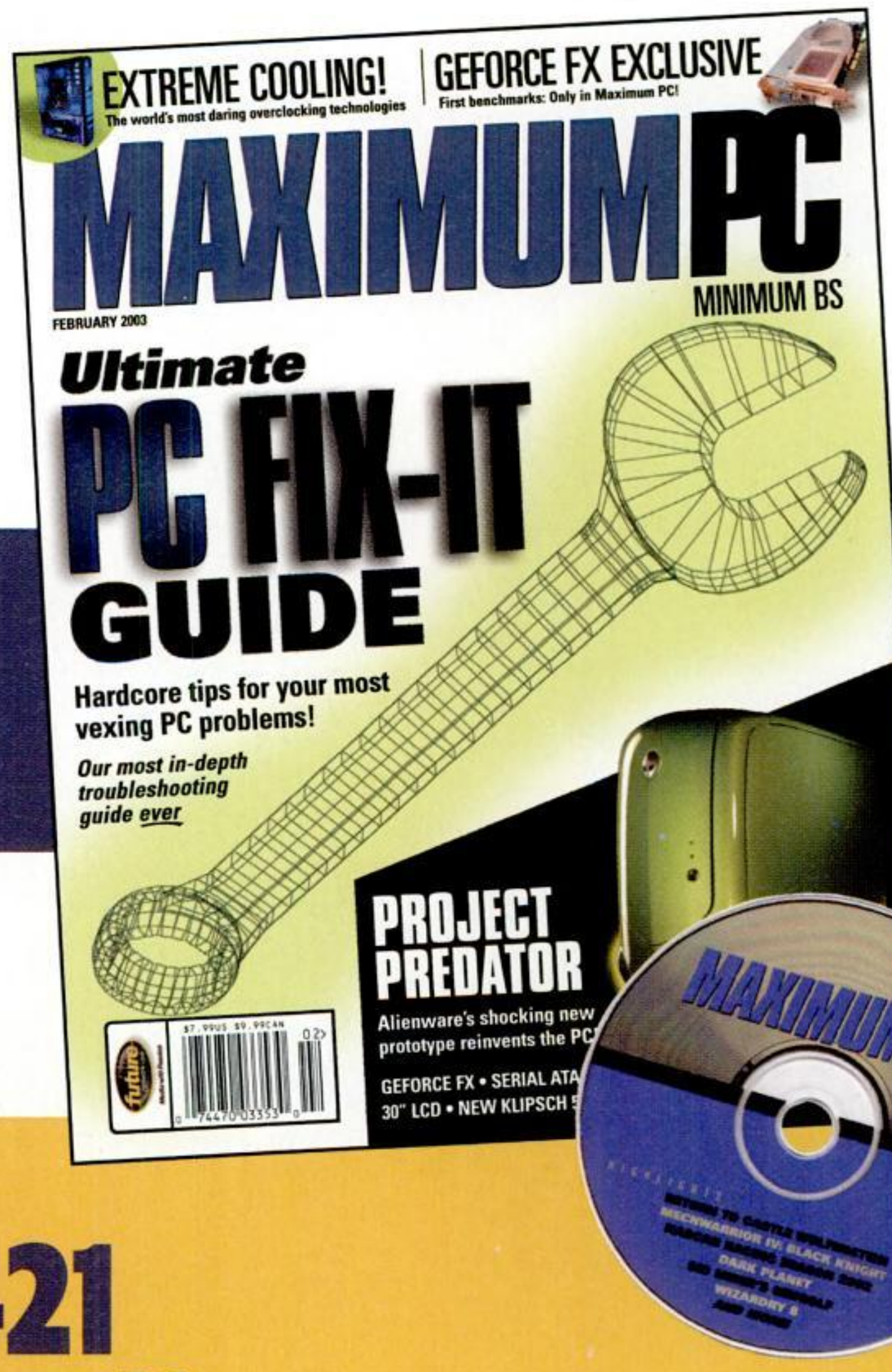

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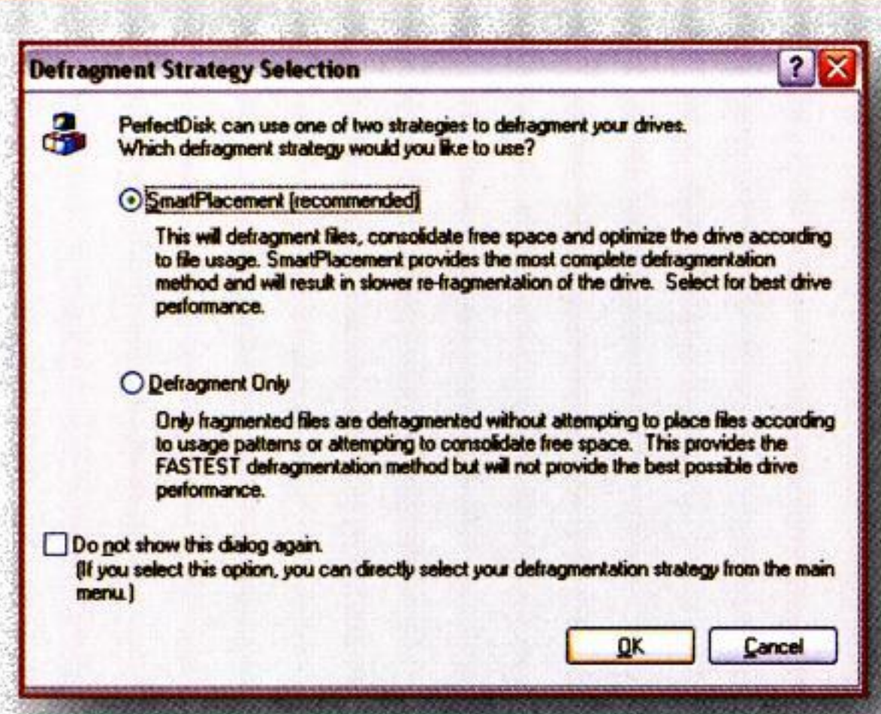


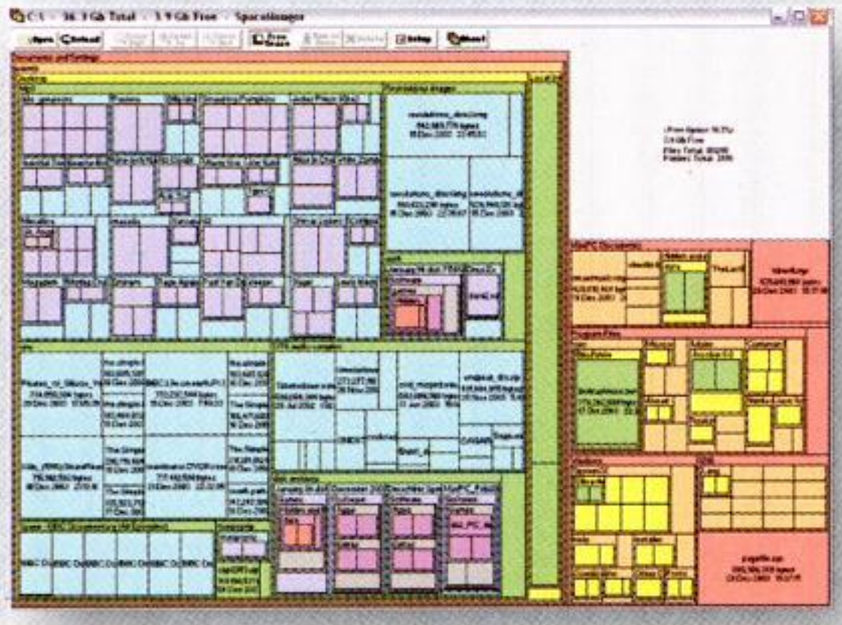
One of the first rules of responsible hard drive ownership is to defrag often.

Question: What's the best hard-drive defragmenting utility?

A: When your hard drive saves data, it can't always put all the pieces of data in sequential blocks right next to one another. Sometimes it has to put a piece here, another piece there, and other pieces scattered way over yonder. As this happens over and over again, a drive becomes "fragmented," which slows your system down because the drive has to search high and low to fetch the data you've requested. To combat this, there are "defragmentation" programs that rearrange all the bits on your hard drive so that related units are next to one another, which speeds up transfer times. If you are using Windows 2000/XP, the Microsoft-supplied defragger is better than nothing, but if you want better performance and faster results, go with *PerfectDisk* (on the included CD). *PerfectDisk* can complete a full defrag with as little as 5 percent free space on the disk, will defrag all Windows system files, and supports scheduling and network drive defragging. Another popular defragmentation utility is *Diskeeper* (also on the disc0), which is from the company that created the defrag utility that ships with Windows.

Question: My drive's filling up, but I can't tell what's hogging the space. What's the best way to keep track of hard drive data?

A: Windows isn't nearly as helpful as it should be when it comes to red-flagging your overstuffed folders. Sure, you can search for big files, but you'll never know what folders might be glutted with small files that add up to big trouble. Grab *SpaceMonger* from the disc included with this magazine to get a handle on the situation. *SpaceMonger* gives you a graphical, proportional look at your drive's contents, and lets you "drill down" into those big folders to see what's taking up so much darn space.



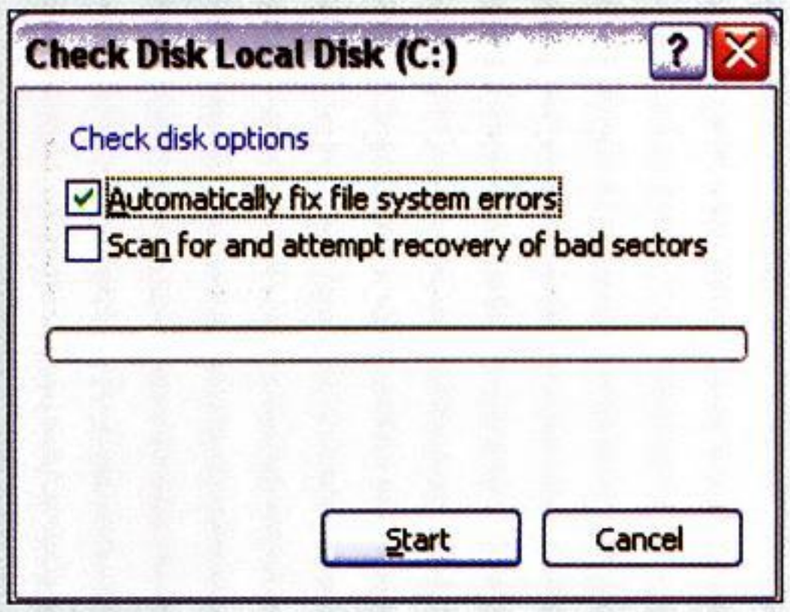
How did that get in here? *SpaceMonger* offers a to-scale representation of your drive's files and folders for easy cleaning.

Question: How often do hard drives fail?

A: Not often, but even once is one time too many. In practice, if you take care of your drives, they should easily outlast the other components in your PC.

Manufacturers used to measure reliability in MTBF, which stands for "Mean Time Between Failures," which is like a product's half-life. These numbers could run into the hundreds of thousands of hours for quality drives (and there are only 8,760 hours in a year!), but since these numbers resulted from a ton of guesswork, they've been supplanted by Annualized Failure/Return Rate (AFR or ARR) and Component Design Life (CDL). Typically, the AFR or ARR on any given drive model is 1 percent or below, meaning that 99 of 100 drives shipped to the field run happily. CDL from most manufacturers is five years. After that, they're not so sure all those moving pars can be trusted, and you're best off transferring your data to a new home.

To make sure you don't get caught in a "hard drive down" scenario, make sure S.M.A.R.T. is enabled in your BIOS (if offered). It will keep an eye on your drive's self-reported diagnostics. Every six months, scan your disk for trouble (go to My Computer, right-click the drive, and select "Tools" then "Error-checking"). If your drive continually indicates a lot of bad sectors, consider it a swan song.

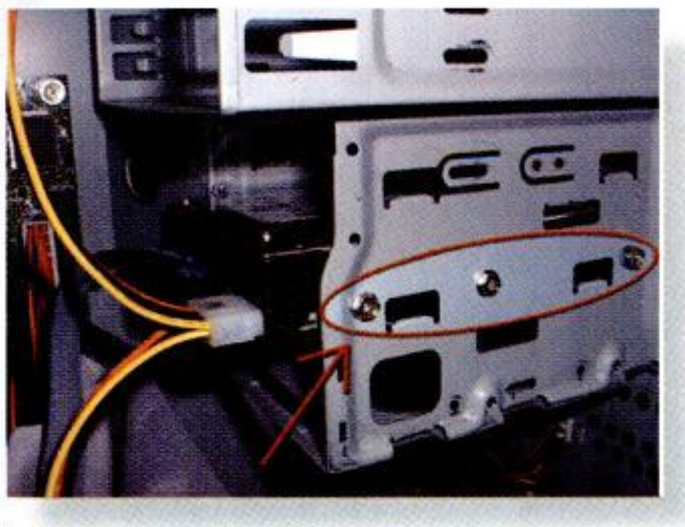


Be sure to check your hard drive for errors every few months, and be sure to always backup your important files!

Question: How much damage can a hard drive take? What precautions should one take when handling a hard drive?

A: If you drop a drive from any distance, there's a good chance there will be some damage. If you're very lucky, the drive will bounce in your favor. If you've gotten away with dropping a drive several feet, we salute you, but the fact is that a drop of just a few inches can be enough to damage a drive. One very certain fact is that drives can take relatively more abuse when they're turned off than when they're running, since the drive's head is usually parked in a safe location off the disk when the drive is turned off.

If you're working on a drive that is removed from the PC, try to work on and over a padded surface. When the drive is inside your PC, be sure to securely mount the drives using all four screw holes in order to dissipate vibrations evenly across the mechanism.



Excessive vibration can throw a drive's read/write head off the scent when it's searching for data, leading to reduced access times. Always mount a drive securely, with *at least* two screws per side.

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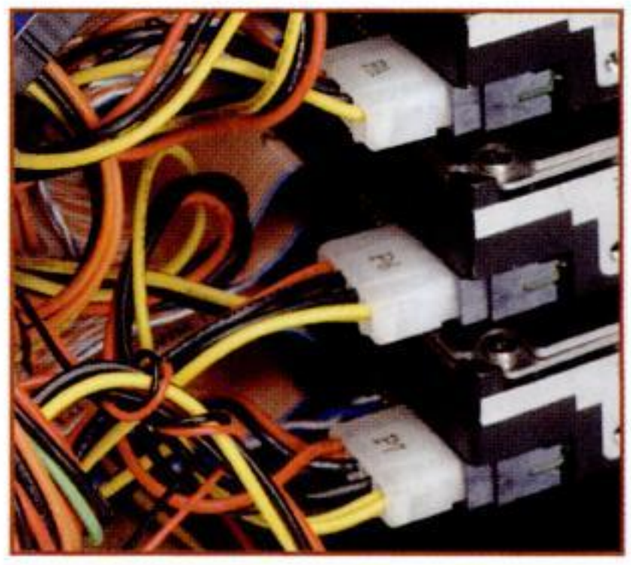
Putting your PC to work

SET UP A RAID ARRAY FOR MORE Speed AND Security



No, this is not a *police* RAID, so you can put your hands down. RAID stands for "Redundant Array of Inexpensive Disks," and it's a technology that allows multiple hard drives to work together as one big hard drive, with each drive sharing a small part of the workload to boost disk transfer rates. Think of it as hard drive teamwork. The two most common RAID configurations are striping, which is two drives working in tandem as one big drive, and mirroring, which is one drive being a mirror image of the other just in case the primary drive crashes. Imagine that—your hard drive crashes and you have an exact duplicate ready to go, just in case!

We're going to set up a "best of both worlds" scenario, with two drives striped and two more drives mirroring them. Also, just for the record, a striped array is called "RAID 0," and the mirrored one is known as "RAID 1." These are essentially different RAID levels, so we're setting up a RAID 0/1 array. RAID may seem scary, but it's actually very easy to set up and offers a host of benefits. Use these instructions to try it for yourself!

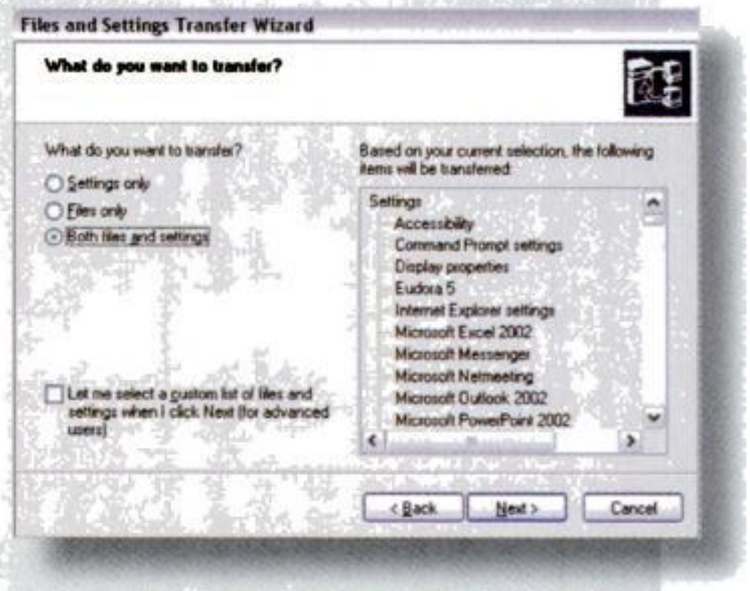
What we'll need:

- **Four hard drives of the same brand and capacity. We used four Western Digital Caviar drives.***
- **ATA RAID controller and drivers**
- **Windows XP CD**

* RAID doesn't require using drives from the same brand or the same capacity, but it's advised to do so in order to reduce the possibility of conflicts between drives. Also, if you use two drives of differing capacities the bigger of the two will only be able to use the capacity of the smaller drive.

Step 1.
Back up your existing files

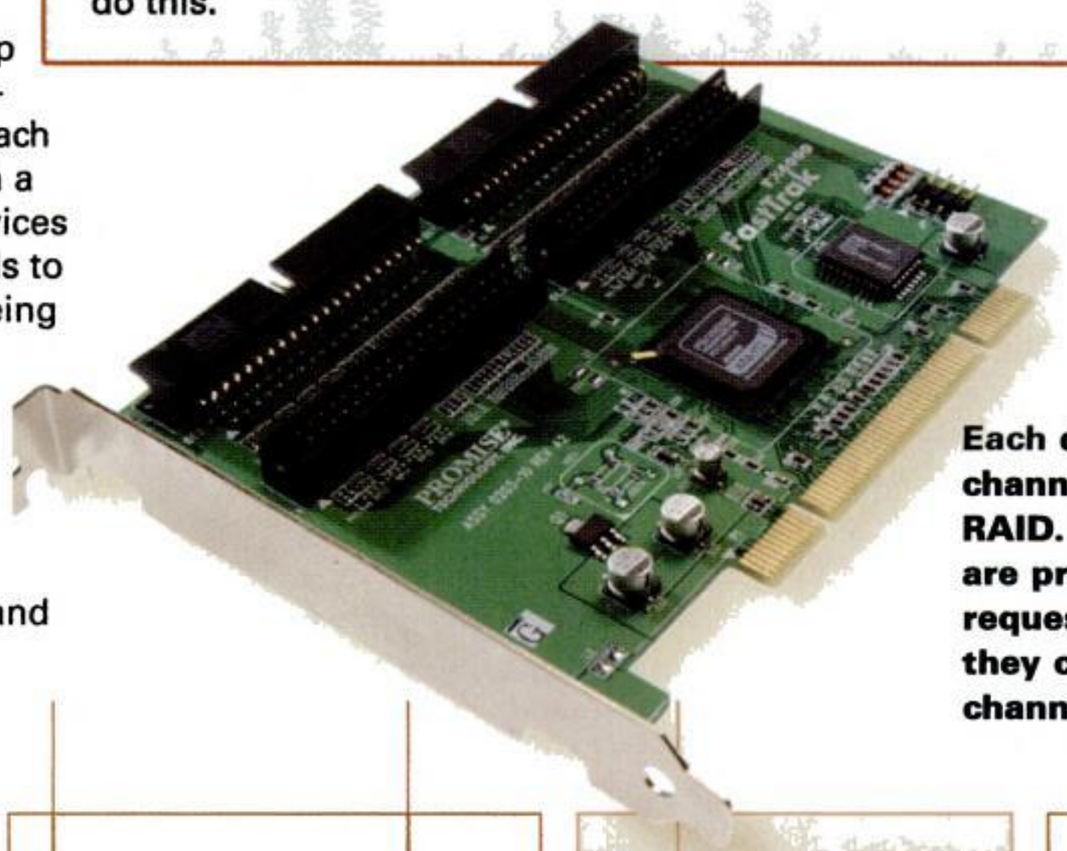
In order to integrate your current hard drive into a RAID array, you'll have to wipe it clean, so back up your important files before you begin. There are numerous ways to back up your important files, but the most painless method is to use the Files and Settings Transfer Wizard built into Windows XP. If you're wondering whether it is possible to just add a second drive to your system for RAID without reformatting your hard drives, the answer is "no." The RAID controller has to prepare both drives in order to receive data in a striped fashion and cannot simply migrate half the data to the other drive in the array. So back up your important things (save games, favorites, e-mail, documents) and let's get ready to do this.



XP's Files and Settings Transfer Wizard is not the most efficient way to back up your files, but it's certainly the most painless.

Step 2.
Are you RAID-y?

Now it's time to connect the drives and set up our array. Most consumer-level RAID controllers support two to four IDE channels, with each channel set aside for a single drive. Although a standard IDE channel supports up to two devices (Master and Slave), for RAID each drive needs to be on its own channel since the drives are being used at the same time to fulfill requests in parallel. Since we are creating a four-drive array, we snagged a four-port RAID controller from Promise (http://www.promise.com), which makes superlative ATA RAID products. The first step then is to simply install the PCI RAID controller, connect each drive, and boot the PC.



Each drive gets its own channel when using RAID. Because the drives are processing the same request simultaneously, they cannot share a channel.

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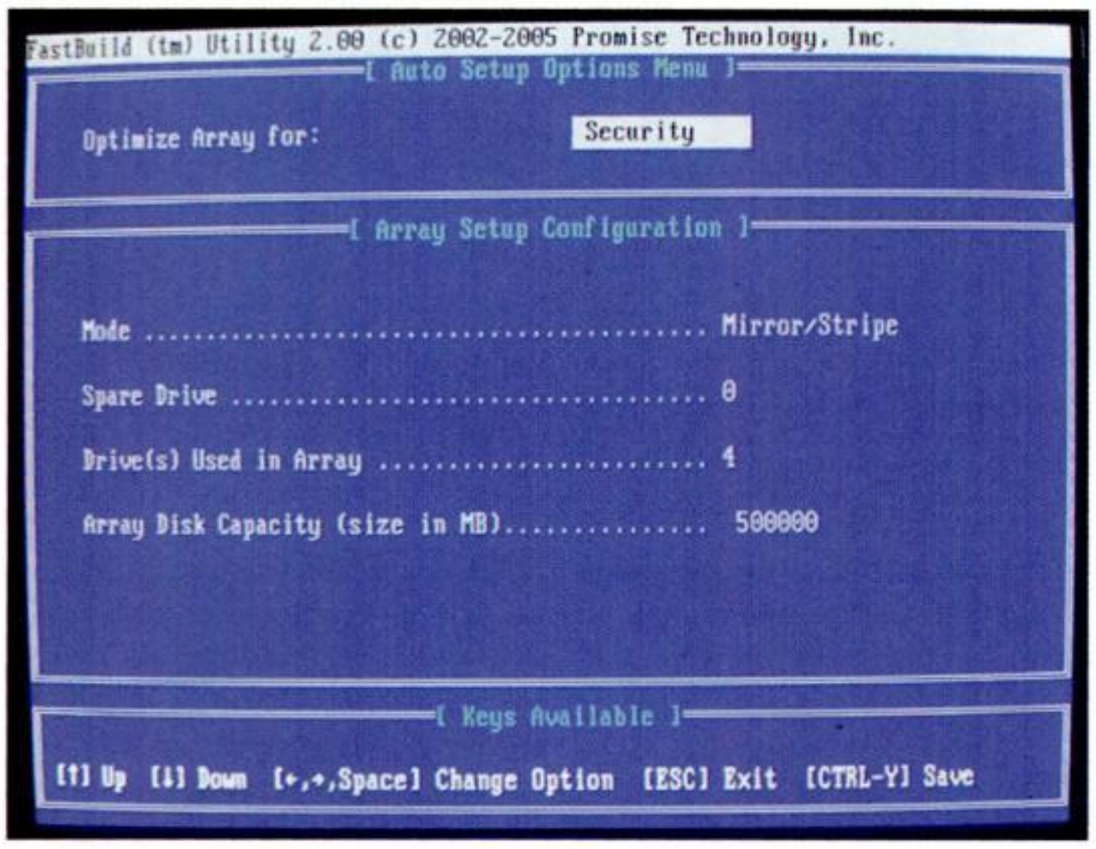
Step 3.
Create the array

Once the PC boots, you'll see a screen indicating that the controller is connected and is looking for hard drives. At this stage, you hit Ctrl + F to go into the controller's RAID utility, where we will configure the array.

At the main menu, we have to choose between letting the software automatically create the array or doing it manually. Since we prefer simplicity to complexity, we choose to let the controller's software set up the array. It asks us if we want to configure the array for "performance" or "security." If we select the former, it puts all four drives into one big striped array, whereas the latter option creates a two-drive array that is mirrored by the other two drives. Yes! This is what we want, so we choose that option and reboot the PC.



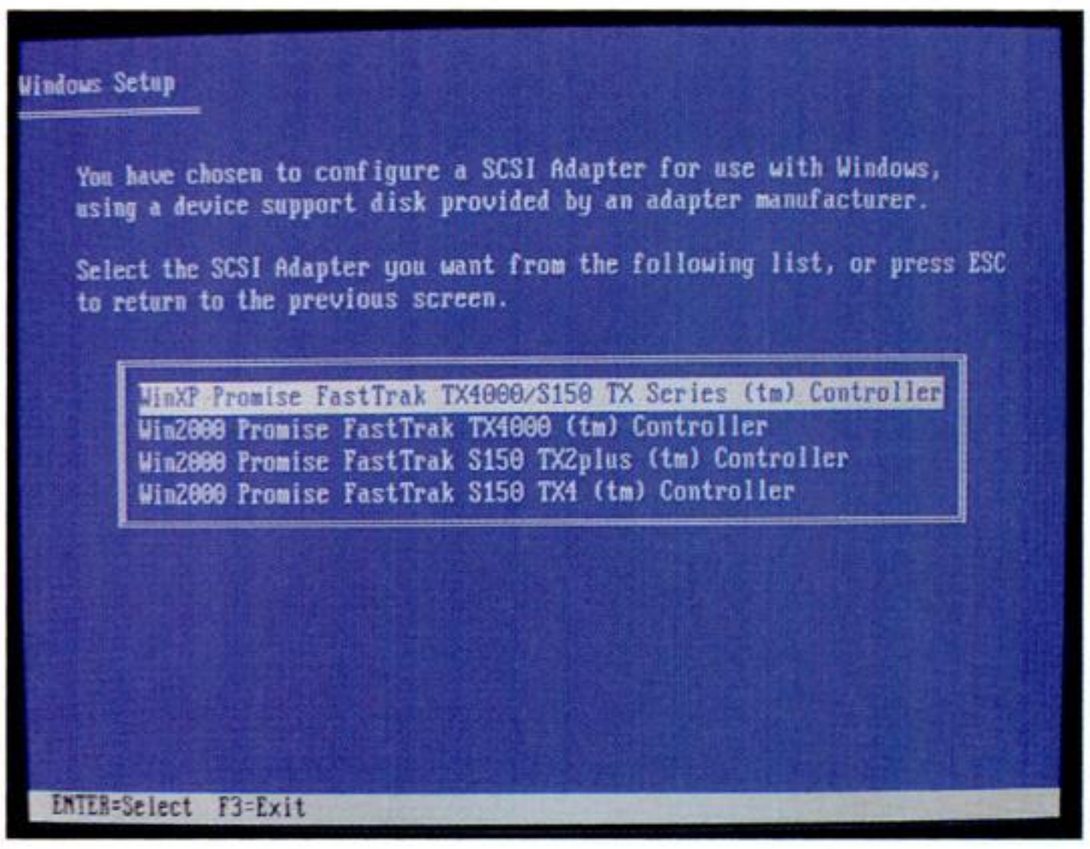
The RAID configuration process is a cakewalk. We just selected to optimize the array for "security" and the software set everything else up.

Step 4.
Get your priorities straight

Upon reboot, press F2 or Del in order to get into your PC's BIOS. Under the "Boot Sequence" screen in your BIOS, select your optical drive as the first device under the "Boot Priority" screen and plop the Windows XP CD into the tray. Make sure you have the drivers for the RAID controller on a floppy drive (usually included with the controller) and reboot. It's now time to install Windows.

Step 5.
The Windows Install

As your PC reboots in anticipation of the XP installation, keep a finger poised over the F6 key. After Windows "inspects your hardware," you'll see a message on the bottom of the screen to "Press F6 to install a third-party SCSI or RAID driver." When this happens, strike the F6 rapidly with one of your fingers. It will then prompt you to insert the floppy drive containing the drivers, and then prompt you to select your RAID controller from a list it obtains from the driver disc. Choose the one for your operating system and continue with the installation process. At this point, Windows will treat your RAID array as if it were a single drive, so the installation should proceed normally.



Windows will ask you for the RAID controller's drivers, so be sure to have them handy.

Step 6.
Tidying Up

After Windows installation is complete, you need to return once again to the magical kingdom known as the BIOS. Press F2 or Del during bootup to make this voyage. Once you have arrived, return to the Boot Priority screen and make sure the RAID controller is the first boot device. You always want to make sure the drive with your operating system on it is the first boot device, and that is now your brand-new RAID array. Once you've set the controller to be the first device, save your changes and reboot. Voila!—your RAID array is now functional!

A Word of Caution

When you are using a single hard drive in your system, there is a very small chance your drive will fail someday and take all your data with it. Because of this fact, realize that using a two-drive array that is striped effectively doubles your exposure to this calamity (since you are using two drives now, and if either drive fails, the whole array will fail). You can offset this danger by mirroring your striped array, but failing that, make sure to back up important data often.

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Ask the Doctor

Your PC is sick, we've got the cure

NEW DRIVE DILEMMA

I just installed a new hard drive. What is the easiest way to move all my data onto this new drive and then use my old drive for MP3 storage?

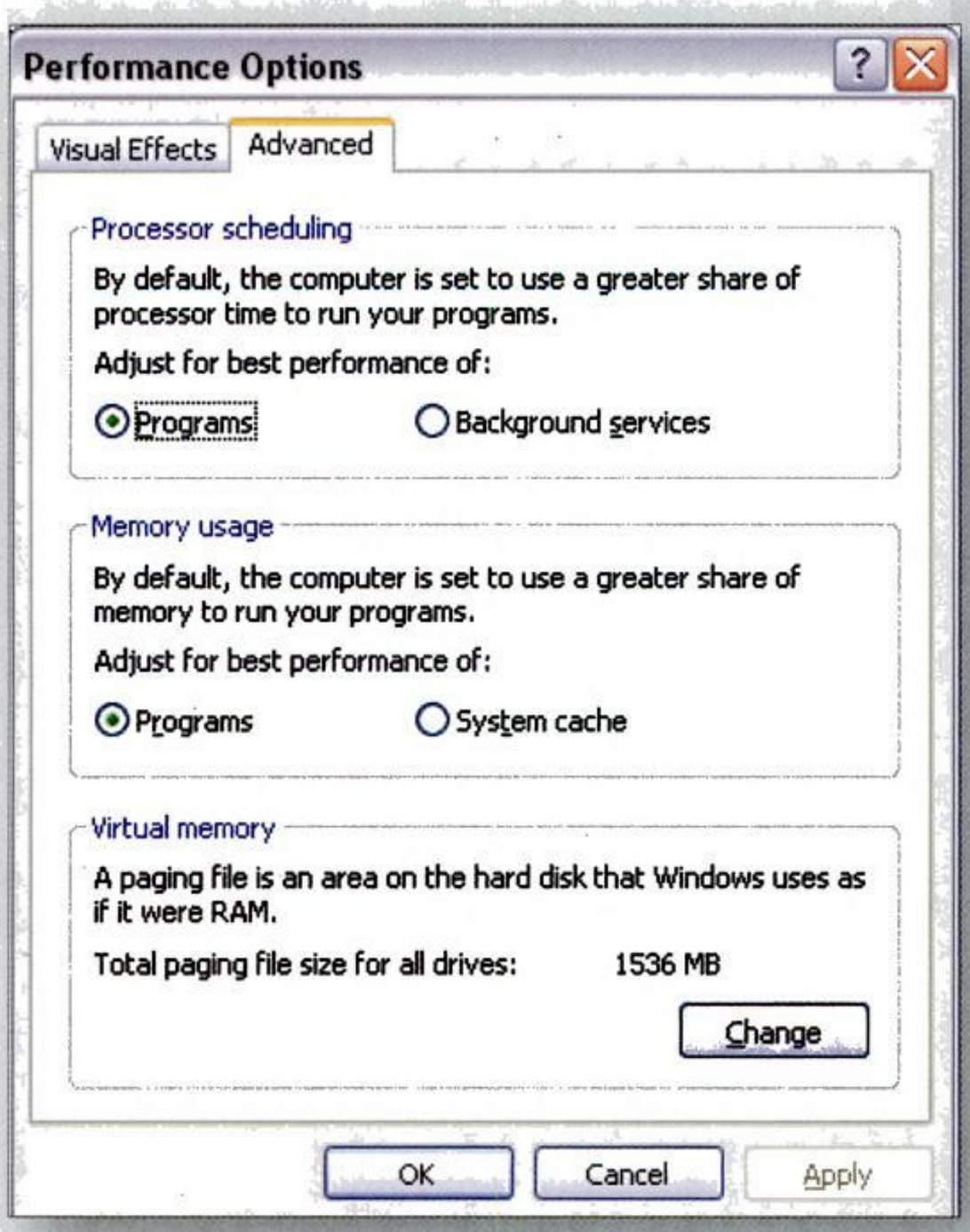
Most retail hard drive packages include utilities for transferring your old data to the new drive. However, we always recommend a fresh install of Windows with a manual update instead. The reason for this is that if your old installation of Windows was clogged with crap, the last thing you want is all that junk on your brand-new drive. So start fresh—you won't regret it.

PUSHING THE SIZE LIMIT

I just bought a 200GB hard drive and Windows is only recognizing 137GB. What's wrong?

The specification for your hard drive's ATA interface allows only 28 bits for addressing data on a disk, which means the maximum it can "see" is 137GB. Now that hard drives are twice as large, the specification has been updated to 48 bits to reflect this jump in capacity. In order to take advantage of this new size limit, you'll need *Service Pack 1* from Microsoft for your operating system and possibly an updated BIOS as well (see our How-to on upgrading your BIOS on page 38). With those installed, you will be able to access all of your hard drive's capacity. Also, one way to sidestep this issue is to use an add-in PCI controller for your hard drives rather than connecting them to the motherboard.

Hard drives typically include data migration utilities, but we recommend a fresh install of Windows on a new drive for peak performance.



You can tell Windows how much hard drive space to use as a swap file, but given how cheap RAM is these days, why not just add more memory if you need it?

IS ATA/133 WORTH IT?

I have an ATA100 hard drive. Should I upgrade to ATA/133 or Serial ATA 150?

Not unless you are looking to buy a bigger drive anyway. If that is the case, then go ahead and get the newer interface, but don't do it thinking you'll see any recognizable speed increase. In fact, most ATA/133 drives are exactly the same internally as ATA/100 drives. Remember: The number after the "ATA" is the maximum transfer rate for *the interface,* not the drive.

MASTER YOUR DRIVE CHAIN

Does it matter if my hard drive is the Master or Slave on its channel? Should I put it on the same chain as my CD-ROM?

If possible, it's best to install any IDE device on its own channel in order to give each device full control of that channel's resources. The reason it's bad to put a CD-ROM on the same channel as a hard drive is that the channel can only send and receive data from one device at a time, so if you are using your CD-ROM and the hard drive needs something, it'll have to swap back and forth between then, slowing down both drives. Try to make your primary hard drive the Master on the primary IDE channel, and your CD-ROM the Master on the secondary channel.

SWAPPING OUT YOUR SWAP FILE

What is my hard drive's swap file? Do I need it?

Your hard drive's swap file is a portion of the hard drive that is used when your system's memory is completely full. While you work at your PC, programs that are in use store their data in your system's memory so that you can access it very rapidly. But if you have a lot of applications open and not enough memory, programs will begin to store their data on your hard drive, which is quite slow compared to your PC's lightning-fast memory. If you do a lot of multitasking and have scant memory, you'll need a swap file. If you have a gigabyte of RAM, you probably don't need a swap file.

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OPTICAL DRIVES

Here's a burning sensation you'll love!

Q **Does it make any difference what color or brand of media I use?**

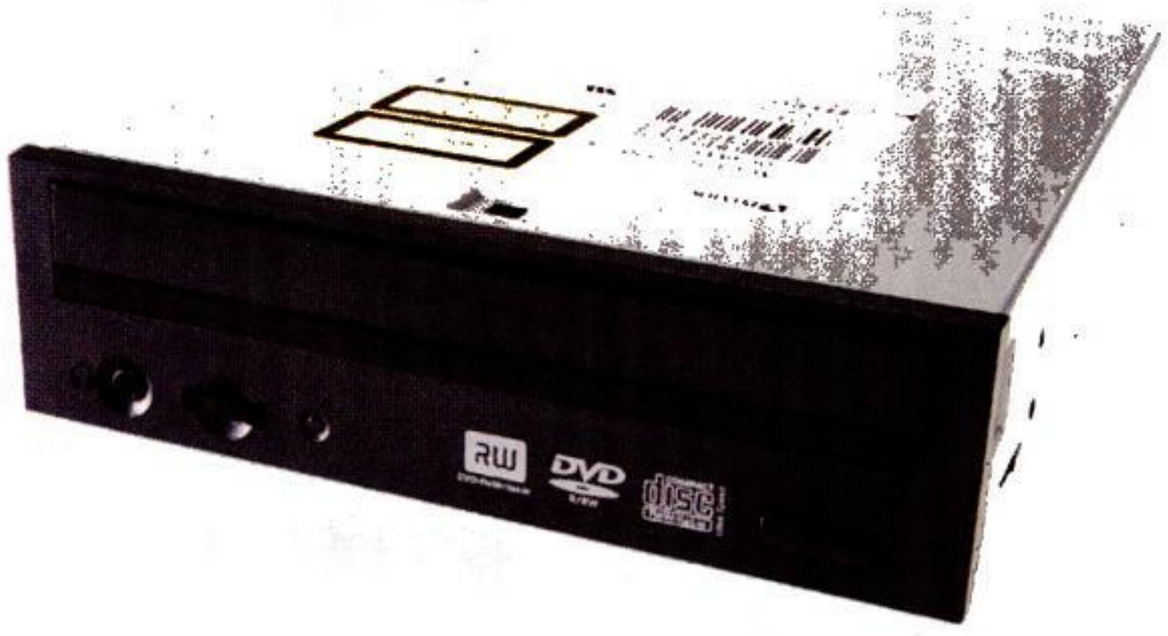
Which one should you use? That's easy. Check the documentation that came with your optical drive, or the manufacturer's website for media recommendations. These recommendations didn't come about as a result of back-alley deals or bribes of exotic whiskey. You'll find some media brands recommended over others because these discs have been specifically tested with the manufacturers' drives. The proper laser strength for each type of media has been evaluated and programmed into the drive's firmware.

In general, we do not recommend buying cheap spindles of off-brand media, no matter how inexpensive they are. El Cheapo vendors aren't worried about brand loyalty, so they skimp on quality control and you pay the price in discs that are error-prone or that won't retain their data for very long.

When the compact disc was introduced by Philips and Sony in 1979, vinyl records had the misfortune to be standing directly in its path. These black, circular monstrosities—with their fragile surfaces and analog data—couldn't compete with the CD's deadly combination of digital clarity and rugged portability. A few years later, engineers figured out how to adapt audio CD technology for use with computer data by adding strong error detection and correction schemes, which led to the downfall of the floppy disk. This storage medium then evolved to DVD, which has taken over as the standard to distribute audio, data, and video to consumers. Today, it continues to evolve at an astounding pace.

Both CD and DVD drives fall under the banner of "optical storage." These drives contain a laser, and when a disc is inserted the laser "looks" at the surface of a disc, where information is encoded in a single spiral track that begins in the center of the disk and moves outward toward the edges. The laser is looking for variations in the surface of the disc, from which it derives digital data (ones and zeroes, in other words). The spiral track in a commercial CD-ROM contains a series of bumps and flat surfaces called "pits" and "lands" embedded in a clear layer just below the disc's outer surface. These "pits" and "lands" represent ones and zeroes and are the building blocks of data. Recordable CDs, or "burned" CDs, work in a similar way. Commercial, write-once and recordable DVDs use these same principles to store information.

In the upcoming year the basic optical technology won't be coming in for any major overhauls, but we certainly expect to see big increases in both DVD recording speeds (they are currently pegged at a relatively pokey 8x) and disc capacities. We're not sure how quickly manufacturers will be able to ramp up recording speeds, but in terms of capacity increases we'll definitely be seeing dual-layer recordable DVD drives this year, hopefully by summer. These drives will be able to encode data on a semitransparent disc layer, and then refocus to encode more data on the layer immediately beneath—nearly doubling the capacity of current recordable DVDs!



Plextor's PX-708A is unique among DVD burners in that it can burn relatively inexpensive 4x media at 8x speeds! You gotta love that.

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OPTICAL DRIVES Tech Terms

All the specs and tech lingo explained

Audio Extraction
The process of copying audio data from a CD (also known as "ripping"). Audio CDs include far less formatting and error correction data than data CDs, so audio extraction must be supported by the drive and accomplished via a specific software program.

Blue Laser
A new technology that uses a blue laser beam to boost DVD capacity to 27GB. Due to the much shorter wavelength of the blue laser compared to the red laser, a lot more information can be burned onto a blank DVD using a blue laser than with the thicker red laser.

Buffer
Memory that is built into an optical drive to ensure continuous flow of data to the drive's laser during recording. Data is taken from its source, fed into the drive's buffer, and then spooned to the drive's laser for uninterrupted writing.

Buffer Underrun
When a disc is being "burned," the drive's laser is being fed by the disc's buffer. If the source feeding the buffer is interrupted and the buffer empties, the recording process stops. This is known as a buffer underrun. Today's CD-R and DVD-R drives have technology that prevents this from happening by halting the recording process until the buffer is full again, but drives without this feature must abort the recording process, rendering the disc unusable.

Combo Drive
An optical drive that offers both DVD-R/RW and CD-R/RW burning functionality.

DVD+R/RW
DVD+Recordable/Re-Writable called "plus RW." It's one of two competing recordable DVD formats (the other is "dash RW") whose disks can be played in standard DVD players. DVD+R/RW is supported by a group of companies that includes Philips, Sony, Hewlett-Packard, Dell, Ricoh, and Yamaha.

DVD-R/RW
A DVD rewritable format called "Dash RW," which is supported by the DVD Forum and companies, like Panasonic, Toshiba, Apple Computer, Hitachi, NEC, Pioneer, Samsung, and Sharp.

Dual-Format DVD Burner
DVD burners that can read both DVD+R/RW and DVD-R/RW discs, as opposed to single-format drives that only can read +R or –R disks.

Dual-Sided
Some factory-pressed DVDs contain data on both sides of the disc. These are essentially two DVDs placed back to back, and need to be flipped manually for data on the opposing side to be accessed.

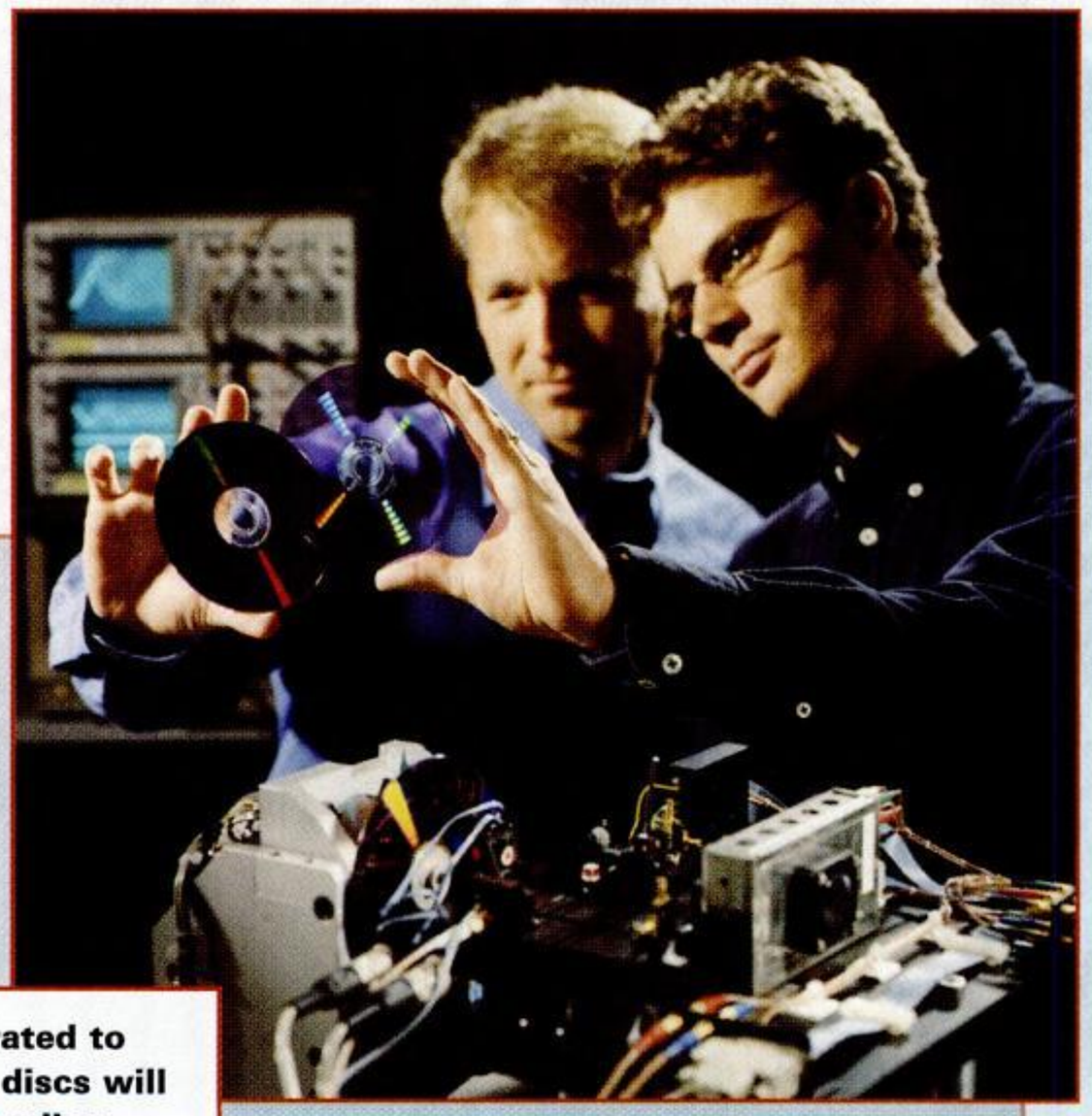
Dual-Layer
Some factory-pressed DVDs contain data on two layers for a total capacity of around 9.4 GB. While all DVD players, including DVD-ROMs, can fully access dual-layer discs, all current recordable DVD formats are based in single-layer technology and are limited to 4.7GB.

Firmware
The software built into a drive that regulates its operation. Firmware is usually stored in EPROM or flash memory on the drive. It can be updated in most drives, but updates normally are not performed on a regular basis.

Packet Writing
Packet Writing is an alternative process for writing data to a CD. It varies from the standard method of writing information in a single, continuous track around the CD. Packet writing allows data to be written in small, individual chunks. Discs must be formatted before packet writing can be used on them.

Random Access Time
How long it takes for a drive to locate and access a random piece of data on a disc, usually measured in milliseconds.

Red Laser
The conventional red laser beam used in today's DVD players and recorders. The size of the red laser beam restricts a rewritable DVD's capacity to around 4.7 GB per layer.



This dual-layer DVD has been separated to show its separate layers, but retail discs will look like a standard DVD recordable disc.

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OPTICAL DRIVES Cheat Sheet

You've got questions, we've got answers

Kiss Technology's DP-500 Networked DVD Player represents an end-run around the DVD format wars because it reads all of them!

Question: What's the best DVD-burning format for making DVD-Video discs that will play in my set-top DVD deck?

A: Our tests have shown that the format with the highest compatibility among set-top players is DVD-R, followed by DVD+R, DVD-RW, and then DVD+RW. But the compatibility difference between DVD-R and DVD+R is very slight, and newer models of set-top players are tweaked to recognize all or most of these formats. So the most reliable approach is to spend a little extra cash for a dual-format burner and experiment with different types of media.

Alternatively, you can buy a newer-model DVD player that will not only read all the recordable formats, but that also will offer niceties like progressive scan playback.

Question: Are non-combo, non-dual-format drives even relevant anymore? Why would anyone ever buy a dedicated DVD-ROM drive, CD-ROM drive, or CD-RW burner in this day and age?

A: Today's optical storage market is divided among drives that record to CD-R, DVD-R, or both. Drives that do both are known as "combo" drives, while drives dedicated to recording in one format are called, "dedicated" drives. A general rule of thumb is that dedicated drives tend to offer higher speeds than combo drives, but the speed differential is often negligible. But there are still good reasons to look at dedicated or single-format drives. For example, Plextor's ultra-foxy PlexWriter Premium CD-RW drive doesn't burn DVDs, but it offers a staggering amount of one-of-a-kind features, like the ability to tweak laser strength for higher compatibility with your audio equipment, and to "overburn" discs so that ordinary CDs can contain as much as 1GB of data.

Another reason to covet a dedicated drive is price. For example, if you know your set-top DVD player can read DVD-R discs, don't waste your money on a dual-format burner when you can buy a less expensive single-format burner.

Single-purpose drives, like Plextor's incredibly fast and featurific PlexWriter Premium, can still be sexy.

Next-generation DVD burners will use blue lasers to create an ultra-high capacity storage medium, but they won't arrive until the end of 2004.

Question: What's the difference between red-laser and blue-laser optical drives?

Well, there's the color, for one thing. Ahem. Red lasers are used in today's garden-variety CD and DVD burners. CD burners use an infrared laser that has a wavelength of 780nm (nanometers) to burn discs. DVD burners user a red laser with a wavelength of 650nm, which is why you can write so much more information on a DVD. Think of it like writing with a sharp pencil instead of a dull crayon; you'd be able to fit many more words on a piece of paper.

Next-generation optical drives are being designed with blue lasers that have a wavelength of only 405nm, so they are able to fit even more information on a single disc. Blu-ray is a long way away, though, and we're not even sure if it will make it to market in 2004. Due to this ambivalence, we'd advise to just stick with straight-up DVD-R for the time being.

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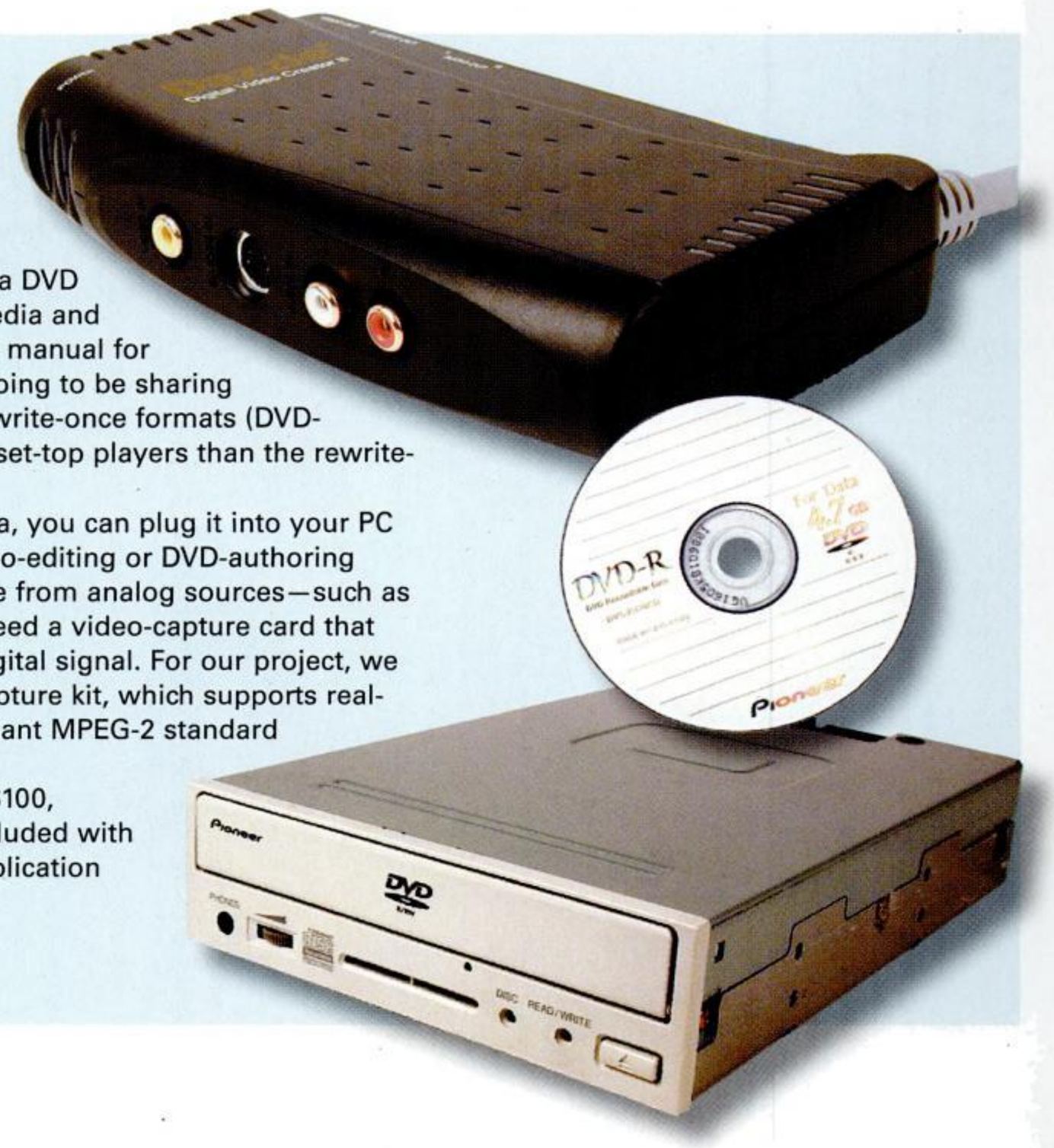
MAKE Your own DVD

Don't sweat it, it's easier than you think

Now that recordable DVD drives cost under $200, there's no longer any reason to fumble around with pathetic videotapes. In this how-to, we'll show you how to create a DVD-Video out of your own analog or digital footage that can be played on most set-top DVD players and PC DVD-ROM drives.

Luckily, the software that comes with most DVD burners handles most of the hard work, such as compressing your video and creating the proper file structure for the disc. This leaves you more time to do what you've always wanted to do—direct!

The Essentials



In order to create your own DVD, you'll need a DVD burner, the appropriate type of recordable media and content creation software. (Check your drive's manual for specific media recommendations.) If you're going to be sharing your DVD with others, keep in mind that the write-once formats (DVD-R and DVD+R) and far more compatible with set-top players than the rewriteable formats (DVD-RW and DVD+RW).

If you have a FireWire-equipped DV camera, you can plug it into your PC and import the footage directly into your video-editing or DVD-authoring application. But if you want to archive footage from analog sources—such as videotapes or an analog camcorder—you'll need a video-capture card that converts the analog signal to a PC-friendly digital signal. For our project, we used Dazzle's Digital Video Creator II video capture kit, which supports real-time compression of video to the DVD-compliant MPEG-2 standard and is ideal for DVD-Video.

For DVD mastering, we used MyDVD 5.0 ($100, www.sonic.com, try the demo on the disc included with this magazine), a capable and easy-to-use application bundled with many consumer DVD burners.

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1 Cinematography

We used the Dazzle capture kit to digitize footage of our favorite pooches, Lucy and Greta, from a Sony Hi-8 Handycam. The DVCII provides preset recording templates for sending video to specific formats. In our case, we selected DVD/MPEG-2, which is the highest-quality setting for creating DVD-Video-compliant video.

2 The Director's Chair

It's time to fire up *MyDVD 5.0*. At the introductory screen, select "Create or Modify a DVD-Video Project." Again, if you have a FireWire-equipped DV camera, you can record directly to DVD from within MyDVD by selecting "Transfer Video Direct-to-DVD," but you won't be able to customize the menus or edit footage, other than at the beginning or end of clips. In our case, we knew we'd need to edit more extensively—for example, Lucy's embarrassing bathroom break in the middle of one take—using Dazzle's video-editing capabilities.

3 Preproduction

After selecting "Create or Modify a DVD-Video Project," you'll be presented with the DVD-authoring equivalent of a blank canvas. Don't worry about customizing the template just yet—you can modify your work later with different fonts, backgrounds, and button styles after you've imported your video.

4 Making Sub Menus

Of course, there were a number of gripping sequences that didn't make it into our final cut, so we're going to let viewers in on some of the behind-the-scenes action by dropping in a menu button to access these other clips. To do this, we clicked "Add Sub-Menu" on the toolbar to the left, and *MyDVD* created a menu button that we renamed "outtakes." We just double-clicked the new menu button to access the new, blank menu, and then followed the same procedure as above to add more video to this submenu. To return to the first screen, just click on the "Home" icon in the DVD display window.

5 Set Dressing

Now you can tailor the video by editing the menu style. Click on the "Edit Style" button on the toolbar at the top of the window. Here's where you'll find the options to switch your menu to a different theme, and to customize these themes with your own fonts, background image, background music (MP3s encoded with a constant bitrate are OK), and even the option to animate your menu buttons with looping video from your own footage! The only things you cannot do are move the button positions off the "grid" alignment and change the appearance of the sub-menu button.

6 Dress Rehearsal

Now we want to see how our disc will work in a DVD-ROM drive or set-top player. *MyDVD* lets you audition discs before they're burned to media by clicking "Preview." A remote control pops up and you can click anywhere on the screen, just as you could with a software DVD player. Or, to emulate the set-top experience, use the remote-control-style buttons at the bottom of the window. This way, you can confirm that menus behave the way you want them to, and that your titles are correct. If not, the project is still fully editable at this stage, so feel free to delete buttons, add menus, and tweak the style to the rewriteable media.

7 The Final Cut

When you're happy with the results you've auditioned within *MyDVD*, exit the preview by clicking the "Stop" button at the bottom of the window. Then click the "Burn" button and save your project to your hard drive (this allows you to edit or update the project later, or simply to reuse your edited style). Click "OK" in the "Make Disc Setup" dialog, and *MyDVD* will begin the process of building your menus, transcoding the video into the proper format and burning the project to disc.

Epilogue

Although *MyDVD* is extremely easy to use from start to finish, it's somewhat light on features (particularly video editing) and customization (you can't move the positions of menu buttons, for example). So once you get the hang of the process of capturing and encoding your footage, consider trading up to a more full-featured product, like Adobe's excellent DVD-authoring app, *Encore DVD* ($550, www.adobe.com). High-end authoring packages will allow you to create menu interfaces that are indistinguishable from professional products. How professional the movies themselves are, well, that's up to you.

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Ask the Doctor

Your PC is sick, we've got the cure

Q MY DVD DRIVE WON'T PLAY A BURNED MOVIE MY FRIEND LOANED ME. WHAT'S GOING ON?

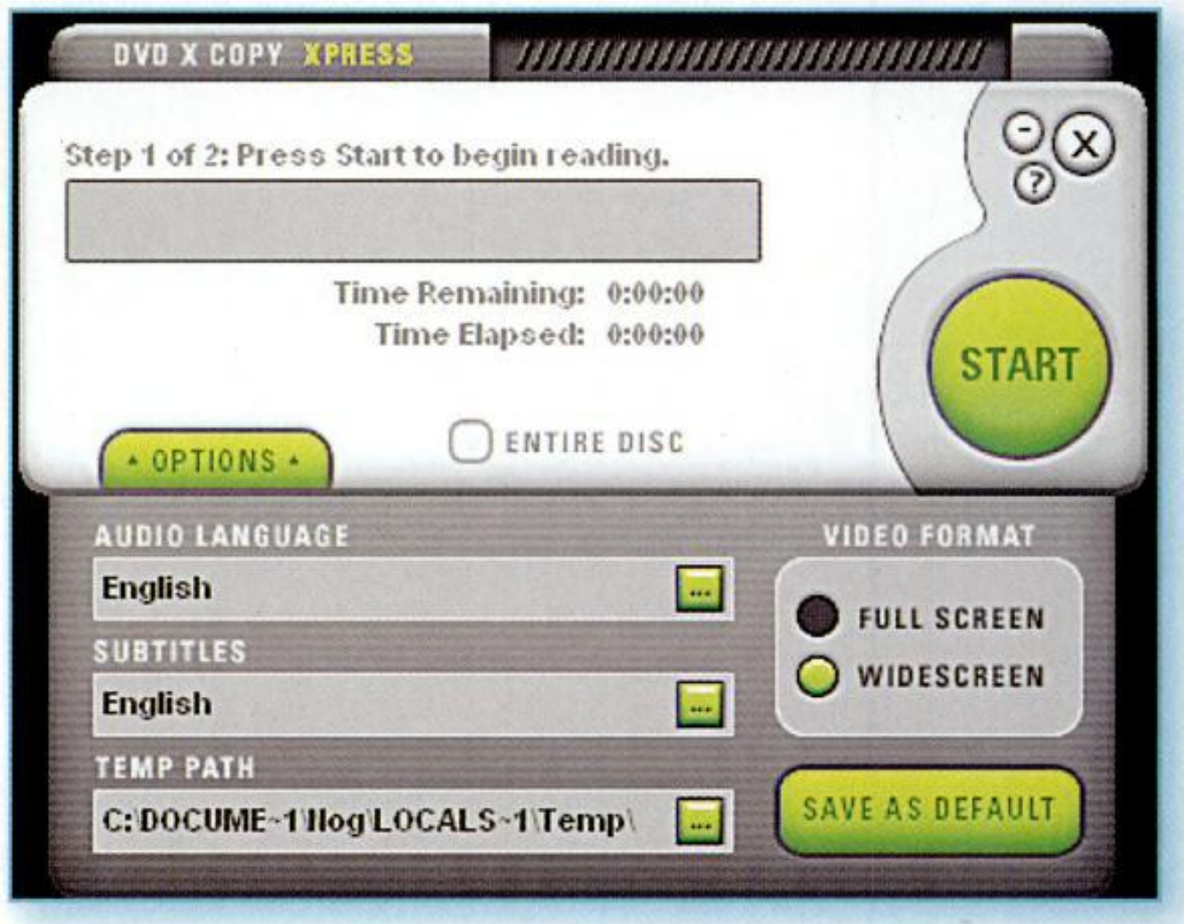
A: Right. Your friend loaned it to you. Wink. Wink. The problem is the disc's format is incompatible with your DVD player, which is rather common. When burning a DVD these days, computer users have to choose one of four competing standards—DVD+R and+RW or DVD-R and -RW. One some set-top boxes, +R works fine but –R does not. On other drives and set-top boxes, it's precisely the opposite. The only way to find out which format is supported by your player is to check the model's specs or to just try one of each and see which works.

Q MY PC ISN'T RECOGNIZING MY CD-RW DRIVE ON BOOTUP.

A: The only reason why any device attached to your PC would not be recognized during bootup is that it's not connected properly, or, if it is connected properly, then it's not configured correctly. Once you have confirmed that the drive's 40-pin cable is firmly attached to both the drive and the motherboard, make sure the drive is correctly set to be either the Master or the Slave on its channel via the little jumpers on its rear (and any other device on its chain is set correctly too). If it's incorrectly jumpered, it will disappear from your system.

Q I'VE GOT A HUGE DVD COLLECTION, BUT JUST HAD A BABY WHO IS NOW ALMOST A YEAR OLD. I HAVE HEARD IT WOULD BE A SMART IDEA TO MAKE BACKUP COPIES OF MY DVDS JUST IN CASE THE LITTLE ONE GETS HUNGRY. CAN I DO THAT?

A: Yes, it's possible, but it may not be legal. Traditionally, it's been legal to make a backup copy of your audio or game CDs under a provision of U.S. copyright law called Fair Use. Unfortunately, this provision doesn't require manufacturers, publishers, or distributors to make backups easy, or even possible. So backups often have been thwarted by copy-protection schemes. In turn, rebel forces found ways around these schemes by using third-party applications that strip out the copy protection.



Is backing up DVDs legal or is it not? Not even your lawyer knows for sure.

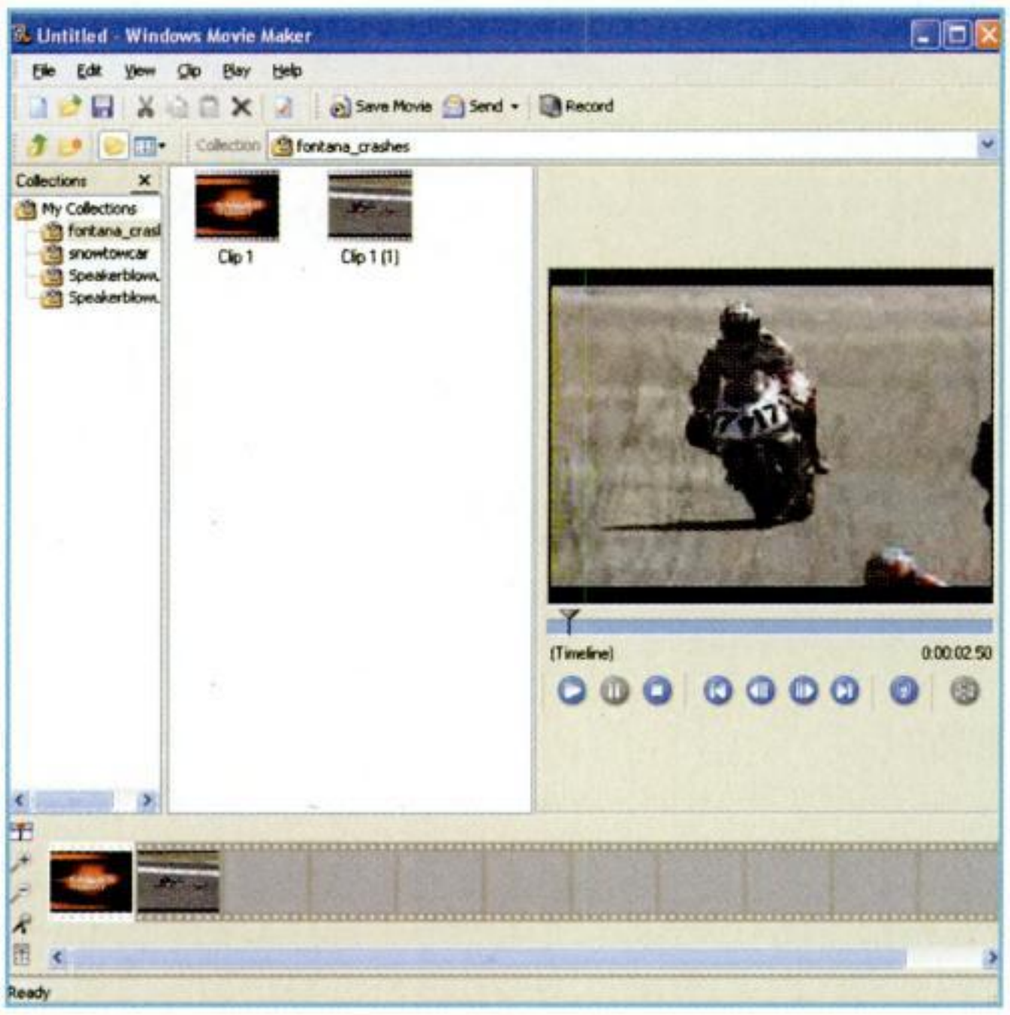
However, in 1998 Congress passed the Digital Millennium Copyright Act, which made it illegal to circumvent software copy protections for any reason. Because DVD-Video discs are encrypted, you need to decrypt them in order to copy or back up their contents. But decrypting them violates the DMCA.

When 321 Studios released *DVDXCopy*, which decrypts and duplicates DVDs for backup purposes, this legal blemish erupted into a full-on litigious spat that is still being hashed out in court. California courts so far have refused to issue an injunction against 321 Studios' software, so *DVDXCopy* remains available, if legally questionable, to consumers today.

Q I HAVE A HOMEMADE MOVIE THAT'S ABOUT 750MB LONG IN AVI FORMAT. HOW CAN I SPLIT IT INTO TWO PARTS SO THAT IT CAN BE BURNED ONTO A VIDEO CD WITH *NERO* AND PLAYED IN MY DVD PLAYER?

The easiest way to do this is with Windows XP's built-in Windows Movie Maker. Go to Start > Programs > Accessories and launch Windows Movie Maker. Before opening your file, go to the View menu, select Options, and make sure "Automatically create clips" is unchecked. Drag your file onto the Clip pane. Click on the clip to activate the Preview window, and move the slider beneath the image to the point at which you want to edit. Once you've hit the right spot, press Control-Shift-S to split the clip into two parts. Drag the first clip to the timeline at the bottom of the screen, and save the movie as a DV-AVI clip. When that's done, highlight the clip by clicking it in the timeline and delete it by pressing—yup—the Delete key. Now perform the same operation using the second half of your video.

If you don't have Windows XP, check out TMPGEnc (www.tmpgenc.net). Using this handy and effective utility can be daunting, but an explicit tutorial for the program is available at www.vcdhelp.com/tmpgencedit.htm



Like a judo chop to a piece of wood, we easily split this video clip into two pieces using Windows *Movie Maker*.

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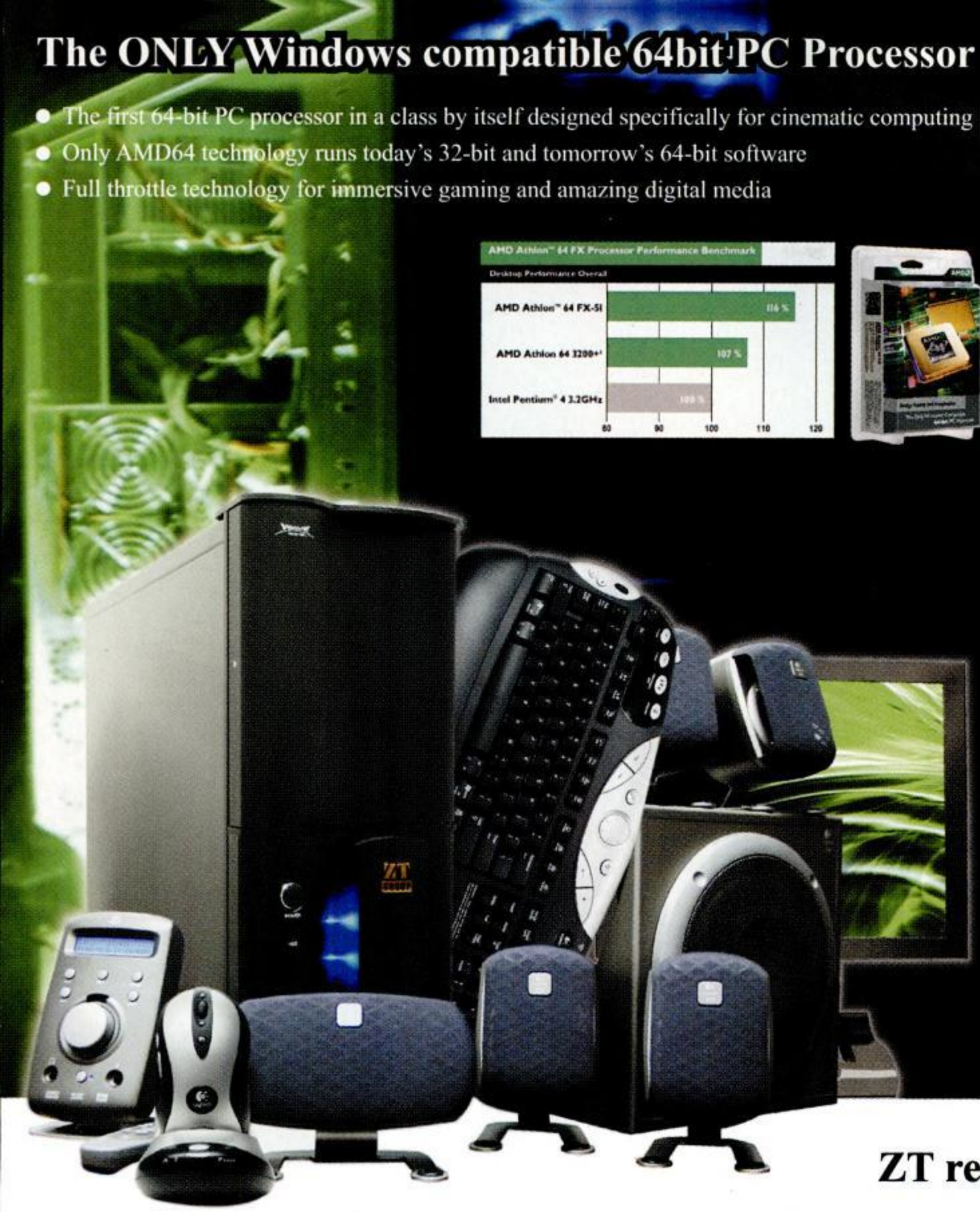

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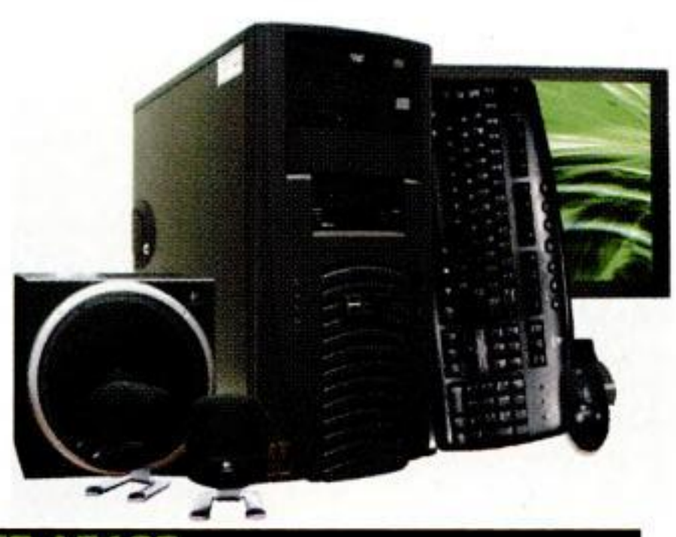

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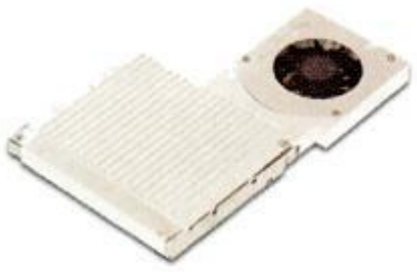
Do-It-Yourself Upgradeable Mobile Graphics Technology



The innovative Area-51m overcomes the technology barrier that has faced mobile gamers for years: graphics upgradeability. The Area-51m now features Do-It-Yourself Upgradeable Mobile Graphics Technology, a modular graphics solution described as "nothing short of revolutionary" by Maximum PC. This feature works similar to a desktop video card, allowing you to upgrade your system when new technology becomes available.

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SOUNDCARDS

Whether you love music, games or movies, nothing brings your PC to life like a killer soundcard. Listen up as we dissect the latest technology!

Q What are the main differences between an add-on card and onboard audio? Is one better than the other?

It's fairly common these days to purchase a motherboard with onboard audio, which means that a chip on the mobo does audio processing so you don't have to buy a separate soundcard to get audio from your system. Like most free lunches though, there is a catch: Onboard audio usually doesn't offer a high level of sound quality, and is lacking in features, compared to an add-in soundcard. In many cases, the onboard audio doesn't even contain a digital signal processor (DSP), which means it must offload the actual audio processing to your CPU, which can cost valuable frames per second in 3D games, lowering the framerate by as much as 5 percent.

In most cases, the biggest limitation of onboard audio is the number of speakers it supports. Most motherboard audio chips contain three minijacks: one for stereo-out, one for microphone-in, and one for line-in, meaning you're going to be stuck with only two speakers. Meanwhile, every soundcard on the market supports at least four speakers, with some supporting up to eight!

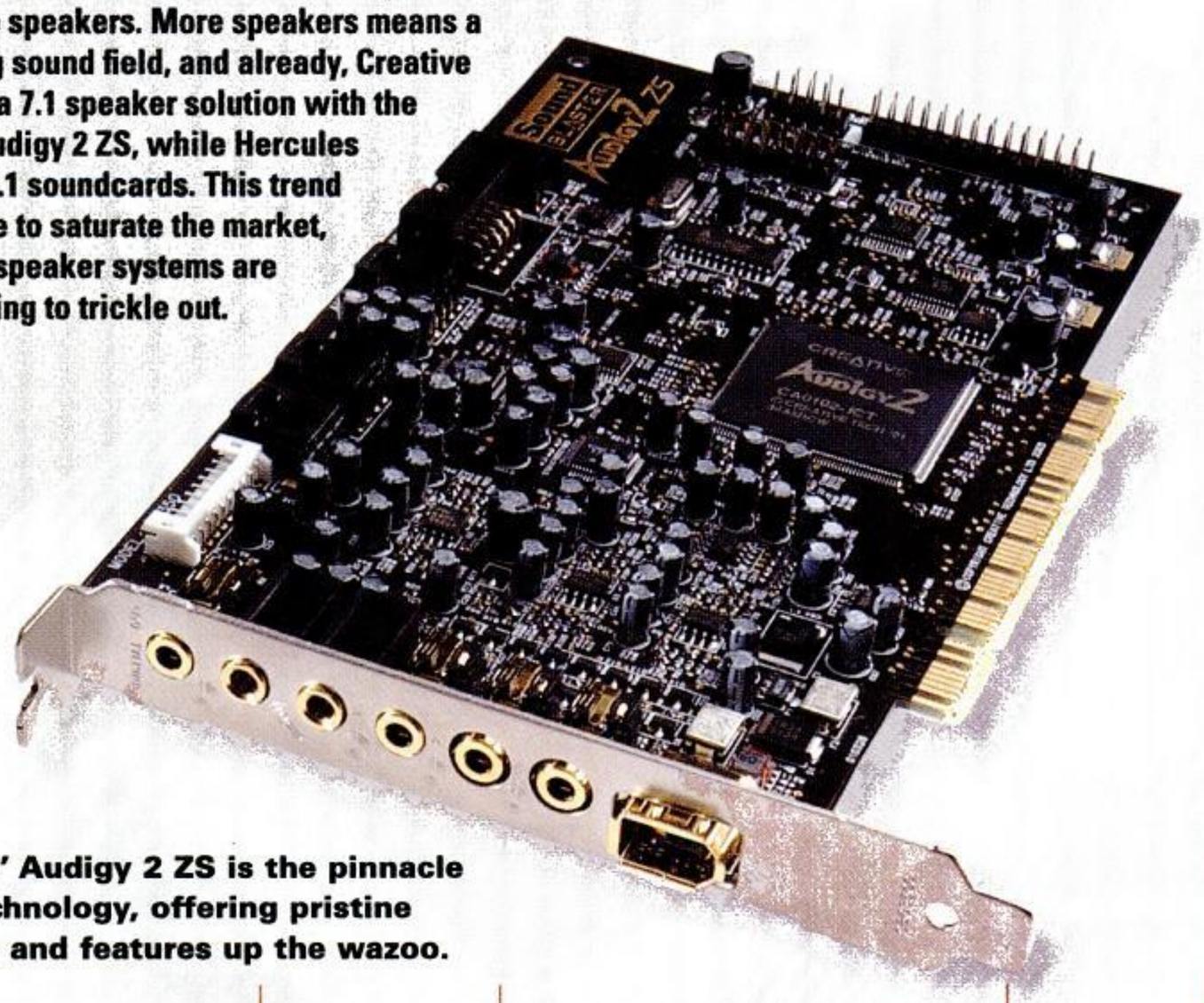
The one exception to the "onboard sound is crap" rule is the nForce 2 chipset found on some AMD-based motherboards. This onboard solution is fully digital and supports 5.1 Dolby Digital surround sound. Its audio quality is excellent as well, so if you buy an nForce 2 motherboard, you won't need an extra soundcard to handle audio duties.

It's true that a lot of people simply use whatever soundcard came with their PCs, figuring that as long as the sound comes out of the speakers, it's good enough. We're here to tell you it's not. There's absolutely no reason to settle for "good enough" when you could be enjoying multi-channel surround sound and audio fidelity so pure your ears will feel dirty listening to it, and all for a relatively modest price.

At the core of today's high-quality soundcards is an audio processing unit that does the majority of the sound processing. Soundcards also can contain surround sound decoders, which separate digital sound streams from DVD movies into discrete channels or analog sounds into separate channels for games. This is called "3D sound," or "positional audio," and a soundcard's ability in this arena is dictated by the hardware or software support for audio code specifically programmed into games. These different types of surround sound for games include Creative Labs' EAX, and Microsoft's DirectSound3D. Some soundcards even have specific optimization for MP3 playback.

The sound card usually will contain a CD pass-through interface that allows the CD or DVD drive to be connected to the soundcard (usually with a thin, gray cable), so that you can play music CDs through the system's speakers. Sound cards usually support at least four speakers: front, left, and right satellites; and surround left and right channels. Some sound devices also provide dedicated support for center/subwoofer channels. Furthermore, most audio hardware includes digital outputs, coaxial, optical, or both.

The biggest trend in sound hardware in upcoming months is support for more speakers. More speakers means a more convincing sound field, and already, Creative Labs is pushing a 7.1 speaker solution with the SoundBlaster Audigy 2 ZS, while Hercules is offering two 7.1 soundcards. This trend will take a while to saturate the market, however, as 7.1 speaker systems are only just beginning to trickle out.



Creative Labs' Audigy 2 ZS is the pinnacle of current technology, offering pristine sound quality and features up the wazoo.

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SOUND CARDS Tech Terms

All the specs and tech lingo explained

24-Bit Audio
Sound that is represented by 24-bits of data every time it is sampled. Traditional CD-quality audio is 16-bit. Using 24 bits improves resolution and fidelity.

API
Application Programming Interface. A set of protocols, subroutines, and data structures that makes it easier for a programmer to produce a sophisticated program by presenting what is akin to ready-made building blocks.

DirectSound 3D
A Microsoft API for representing, manipulating, and delivering sound in three dimensions. DirectSound 3D often is used in software that offers positional sound effects.

Dolby Digital 5.1
A Dolby Laboratories format for representing sound in six discrete channels—five positional channels and a subwoofer channel. This is a popular digital surround sound format, and is used in most DVD movies.

DSP
Digital Signal Processor. The chip that digitally process audio data.

DTS
Digital Theater System. A competing format to Dolby Digital that also delivers sound in discrete channels—five positional channels and a subwoofer channel. albeit at a higher bitrate. DTS is used in some DVD movies and is developed by Digital Theater System, Inc.

DVD Audio
A budding format that uses DVDs to deliver audio with exceptional fidelity. Unlike CDs, which are limited to 16-bit samples at 44.1 KHz, DVD Audio can deliver sound that is sampled at up to 24 bits and 192 KHz.

Game Controller
A joystick, gamepad, or other device used predominantly for gaming purposes. Many soundcards feature a connector for hooking up such devices, which is logically called the "Game Port."

Hardware Channels
The number of separate audio streams that the audio hardware can handle simultaneously. Additional channels often can be simulated in software, but at a significant cost in processor attention.

Host-Based Processing
This is the term that's used to refer to audio processing that's done by a system's CPU rather than a processor found on the soundcard. Since it is expensive to design a soundcard with its own onboard processor, some less expensive models simply skip this step and offload all the processing work to your CPU, which can degrade overall system performance due to heavy CPU utilization levels.

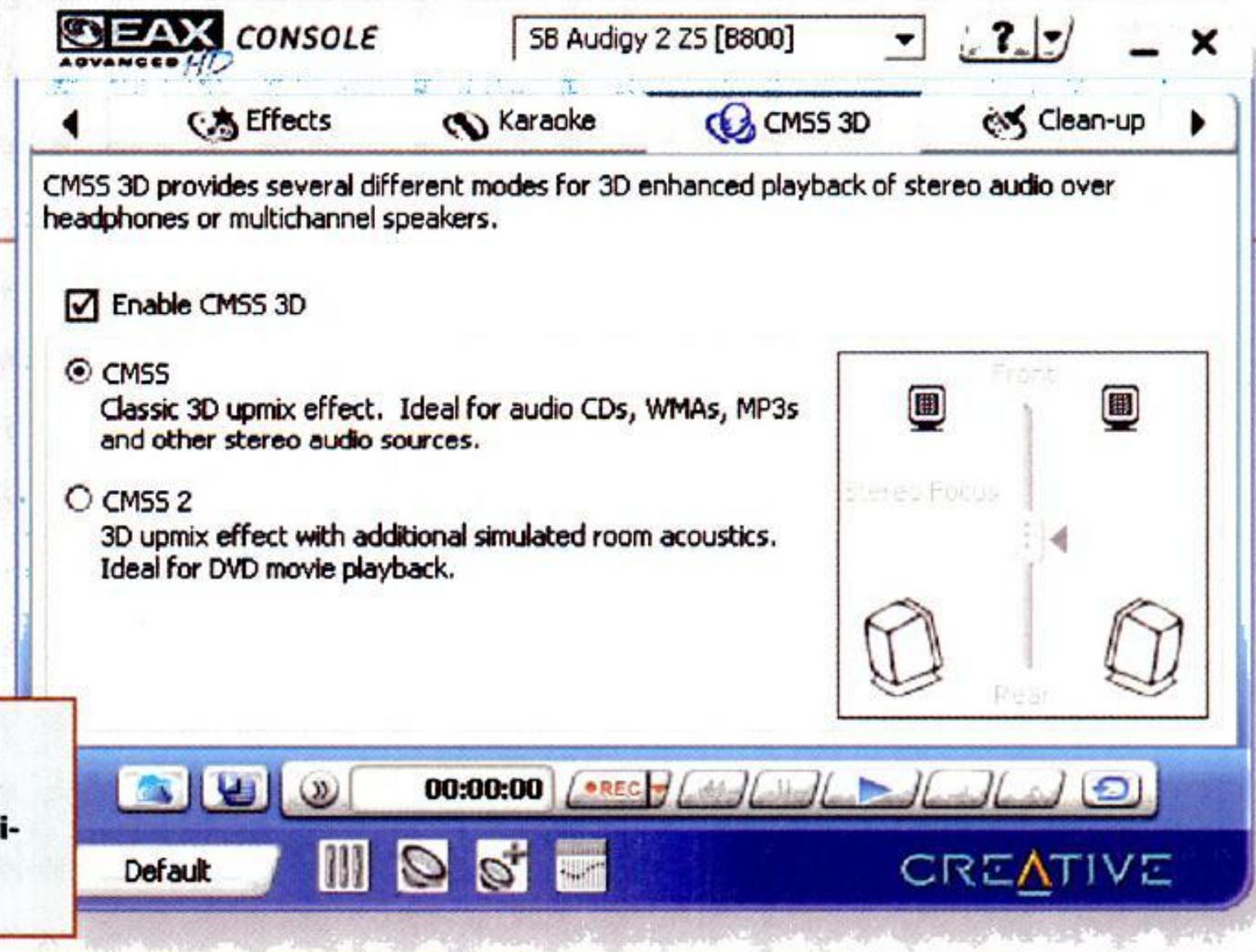
S/PDIF
Sony / Phillips Digital Interface. A format for transferring digital audio data without first converting it to an analog signal. Generally, there are two kinds of S/PDIF connectors: one that uses the traditional RCA cable and one that uses a fiber optic cable.

Sampling Frequency
The number of times the sound data is sampled per unit time. Traditional CD audio is sampled 44,100 times a second, and hence has a sampling frequency of 44.1 KHz.

Signal-to-Noise Ratio
The ratio of audio signal strength to that of unwanted background noise. A higher signal-to-noise ratio usually indicates a superior audio product.

Surround Sound
The delivery of sound to more than two channels, and with multiple speakers positioned in locations that "surround" the audience. The basic surround sound setup uses four speakers—two in front and two behind the audience.

CMSS
Creative Multi-Speaker Surround. A standard developed by Creative Technologies for delivering surround sound by sending a two-channel signal to mutliple channels.



Creative Lab soundcards ship with a nifty technology called CMSS that lets you send a stereo signal to multi-channel speaker systems.

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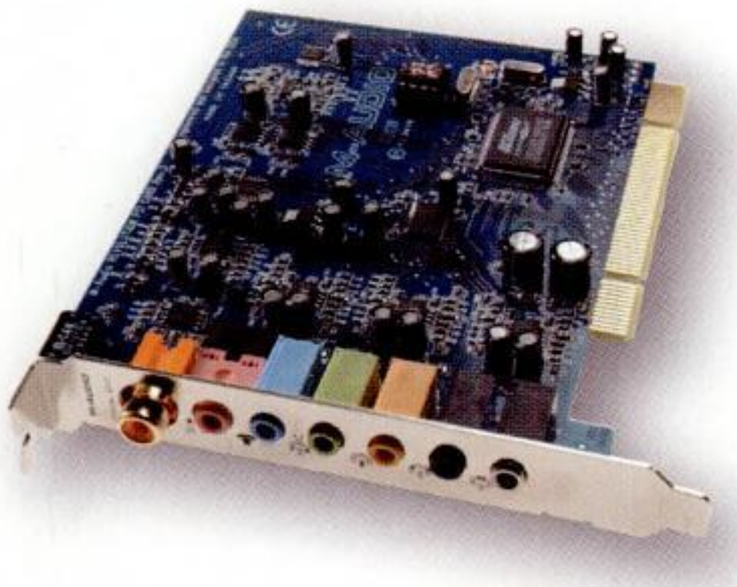
SOUND CARDS Cheat Sheet

You've got questions, we've got answers



The M-Audio Revolution soundcard is a typical "dual use" card in that it offers digital output as well as multi-channel analog output.

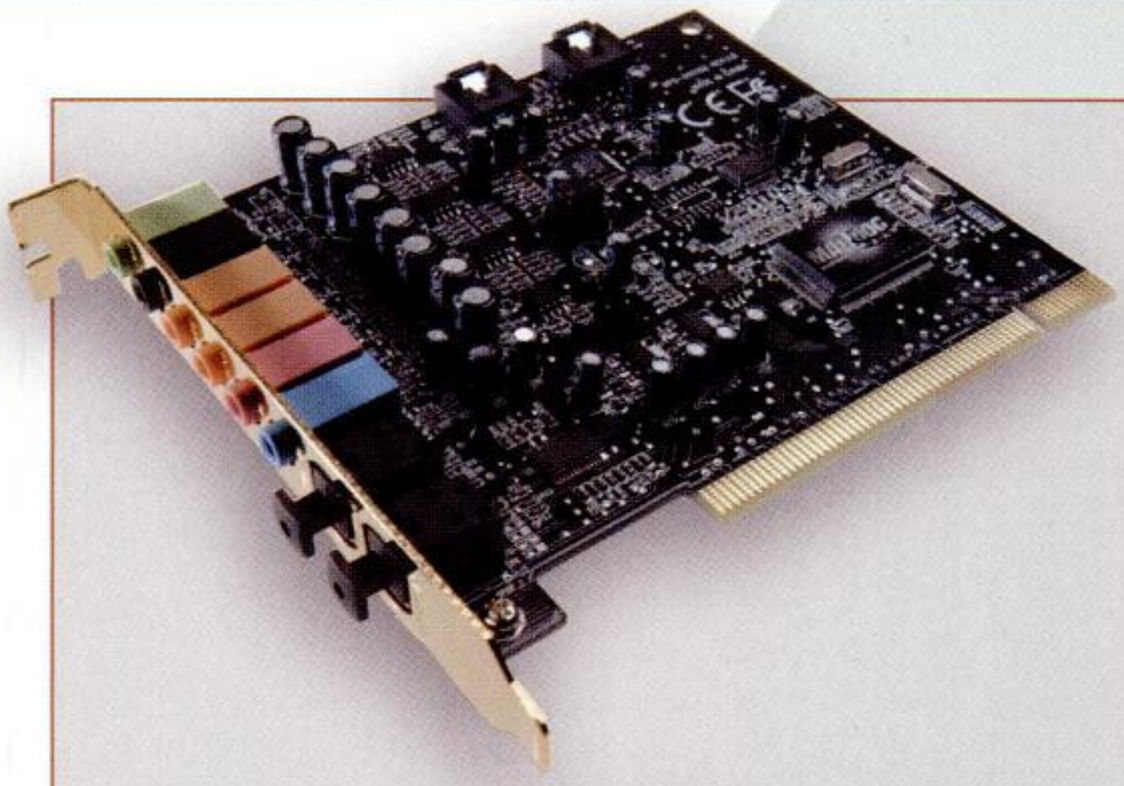
Question: What is the difference between a surround sound card for home theater and a card for gaming and music? Is there any?

A: The primary difference between gaming and home theater is the connections required for each type of sound output. For example, in order to get positional audio from a DVD movie, a soundcard needs a Digital Out connector to send the DVD's audio signal to the speakers. At some point, this digital stream of audio has to be "decoded" into its separate channels, and this decoding can take place either in the soundcard or in the speakers. 3D games are a different story, though, as they typically produce sound that is analog and thus is sent to the soundcard in multiple channels (as opposed to the single-channel digital stream from a DVD movie). To produce these sounds accurately, a soundcard must have different jacks for the front speakers, the center channel, and the rear channel. So today's soundcards need analog output jacks for games and digital output for movies. Luckily, most decent soundcards on the market today offer both types of outputs, making most "gaming" soundcards suitable for home theater as well.

Question: What's the difference between 24-bit/192KHz audio and 16-bit/44.1KHz audio?

A: 16-bit/44.1KHz audio is the specification for CD-quality audio, whereas 24-bit/192KHz sound is recorded at a higher bit rate, meaning it includes more information (or bits of data) about the sound than 16-bit/44.1KHz audio. With a higher bit rate, sound is produced with increased resolution and is able to convey more subtle nuances than with a lower bitrate. Unfortunately, it will be a while before 24-bit/192KHz media becomes commonplace, simply because 16-bit/44KHz is excellent sound quality by most people's standards. Another roadblock to the adoption of 24-bit/192KHz audio is that if you play a CD that was engineered at 16 bits, it won't sound better with a soundcard that's capable of 24-bit resolution. Most 24-bit soundcards do let you record at that resolution, though, which is a nice feature if you do a lot of music recording.

High-res 24-bit audio is available in high-end soundcards and is used mainly in the still-developing DVD-audio specification as well. It provides extremely high levels of musical fidelity.



Buyer beware! This Mad Dog Entertainer 7.1 soundcard looks like a typical high-end card, but it doesn't even have an onboard DSP!

Question: In specific terms, how badly might my 3D gaming frame rates suffer if I use a "host-based" card that relies on my CPU for audio processing chores?

A: Most onboard sound chips (and even some add-in soundcards) offload audio number crunching to the system's CPU, which is generally bad. This is because, during a 3D game, the CPU has its hands full feeding instructions to the videocard, so the last thing it needs is more work. We know how it feels! However, by most benchmarks, the difference in frame rates for a system using a host-based card and an add-in card is usually less than 10 frames per second. If you have a monster gaming rig that has frames to spare, you can afford to send some more work to the CPU. However, if you're running a "budget" system, an add-in card with its own audio processor is the way to go for maximum gaming performance.

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PC RECORDING BASICS

First off, note that you cannot simply connect your guitar to the back of your soundcard. The signal needs to be boosted by an amplifier or pre-amplifier to what is called "line level." The definition of line level is that it's the standard voltage level accepted by an amplifier, mixer or recording device. The signal will not become distorted if it is within this line level tolerance.

Most preamps and some amplifiers offer a line level output, meaning you can run a cable from the amp or preamp into your soundcard, but do not confuse "line level output" with "speaker output." A lot of less expensive amps offer speaker output so that you can send your guitar tone to a set of speakers, but if you plug this into the delicate "line level" input of your soundcard you could fry the soundcard or worse, the motherboard that it is attached to as well. On amplifiers that have the appropriate output, it is simply labeled "line out."

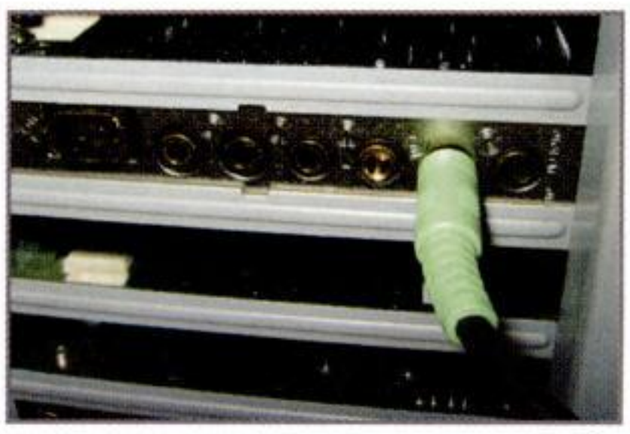
What you'll need:

- **A guitar**
- **A preamp (effects pedal, etc)***
- **Soundcard with line level input or Microphone input**
- **A 1/4" to 1/8" minijack cable ***
- **Recording software**

* This is dependent on your setup.

METHOD 2: USING A PREAMP OR EFFECTS BOX

One way to kill two birds with one stone is to send the signal into a preamp/effects box with a line level output. This accomplishes the task of letting you tweak your tone while sending the signal in the proper format to the soundcard. These boxes sit in between your guitar and soundcard, processing the signal and sending it along its way for the soundcard to pick up. When shopping for one of these units, the key consideration is what kind of effects you are looking for as well as price.



Most soundcards offer an analog in port for plugging in a microphone.

Let's Jam!

METHOD 1: RECORDING FROM A MICROPHONE

If you currently play through an amplifier, there are two ways to get the sound to your PC. One way is to connect a microphone to your soundcard's Mic in port and then place the microphone in front of your amplifier. The benefit of this approach is it is relatively affordable since microphones are rather inexpensive. This is also a good route if you've spent years tweaking your amp's tone to the point where it's perfect and don't want to bother with reconfiguring your tone via a new preamp or effects box. The downside is the mic could pick up ambient noise in your recording area, which will have to be edited out via software, adding complexity and additional expense to your project.

Recording your amp's output with a mic is an easy way to record with your PC.

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METHOD 3: THE BEST OF BOTH WORLDS

As stated in the previous section, the most efficient way to customize your tone and send it to the soundcard at the appropriate signal strength is to use a preamp. In our opinion, the best model on the market is the Guitarport from Line6 (www.guitarport.com).

The Guitarport from Line6 is an all-in-one "solution" for playing a guitar through your PC.

This little red devil works through your computer's USB port and an online software interface to deliver an avalanche of awesome preset tones, effects, amps and features. Here's how it works: You plug your guitar into the front of the unit, then plug the Guitarport into a USB port and connect it to your speakers or plug in headphones. Next you run the included cable from the unit's line out into your soundcard's line input and you're literally ready to rock.

Once you fire up the software it connects to the Guitarport online interface (a Net connection is required to use it) and it's like standing on a stage with 50 different amps at your disposal. The software "models" 15 different amplifiers and 18 effects pedals for an enormous variety of tones, all available at the click on your mouse. It even includes a chromatic tuner!

The Guitarport's connections include a USB port for power, headphone jack, line out and stereo RCA jacks as well.

Once you're up and running, you can play along with audio files saved to your hard drive or play along with lessons available via the online software. The software even lets you slow songs down to half-speed without changing the pitch, making really tough sections easier to figure out. You can even type in "Van Halen" and the software will change the current tone to match Eddie's! It's really an incredible combination of hardware and software that takes all the guesswork and frustration out of this entire process. We can't recommend this product highly enough!

PUTTING IT ON WAX

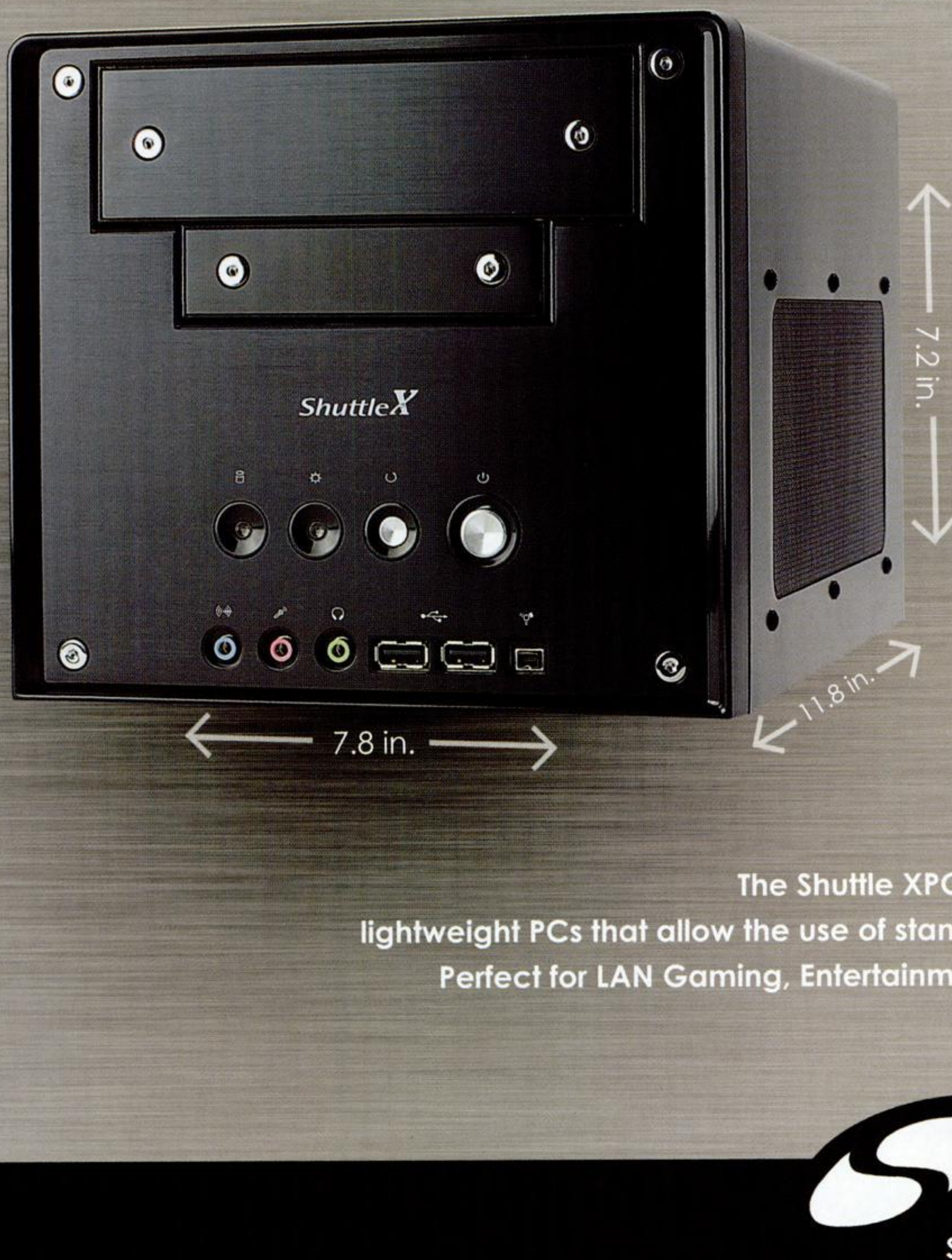
The final step in this process is recording your tracks, which must be done via software. There is an enormous number of software packages on the market to fulfill your recording needs, ranging from the most basic to so advanced they'll make your head spin. If you want the most basic package available, remember that all versions of Windows include a Sound Recorder (Start Menu, Programs, Accessories, Entertainment, Sound Recorder). This rudimentary recorder works fine in a pinch but is so lacking in features we don't recommend it. Our personal favorite due to its ease of use is *Audio Record Wizard* from NowSmart Software. It's nowhere near as advanced as many software packages on the market, but that's why we like it. It has an intuitive interface and can even save your tracks as MP3 which can save you disk space. An evaluation version is on the CD included with this magazine.

Audio Record Wizard is a splendidly simple audio recording package.

If you're looking for a more advanced software suite, check out the following programs and URLs.

GuitarTracks — **http://www.cakewalk.com**
SoundForge — **http://mediasoftware.sonypictures.com/**
n-Track Studio — **http://www.fasoft.com/**
Cool Edit — **www.syntrillium.com**
A great all-around resource — **http://www.guitarists.net**

Shuttle XPC SB75G2
NextGenerationPC



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MP3'S ARE SKIPPING!

When I'm listening to MP3s and access something on my hard drive, the sound skips. How do I stop this from happening?

This is a semi-common problem, and it is almost always the result of a problem on your motherboard's PCI bus (which is where your soundcard is plugged in). The skipping is akin to a traffic jam occuring across the PCI bus, and it is not a normal occuance at all. To remedy this situation, the first thing you should do is update your motherboard's chipset driver (see page 27 for a how-to on this exact subject). This should take care of the skipping problem, and will work in about 90 percent of cases. MP3 skipping is also a known issue with SoundBlaster Live cards plugged into mobos with a VIA south bridge chip.

You might also want to try switching to a different MP3 player, as it may just be a software issue. We like *Winamp* (www.winamp.com) but Windows *Media Player* works well too.

CAN I "LIVE" WITHOUT IT?

I see the SoundBlaster cards are offered with an optional drive bay for more inputs. Do I need that?

If you just listen to music and play games, then no, you don't need it. The "Live Drive" add-in bay includes a slew of I/O ports used for recording music, including MIDI In and MIDI Out ports, Microphone In, Optical In and Out, Coaxial In, and others. However, the drive bay does include a remote control, which is a handy feature if you use your PC as a home entertainment center.

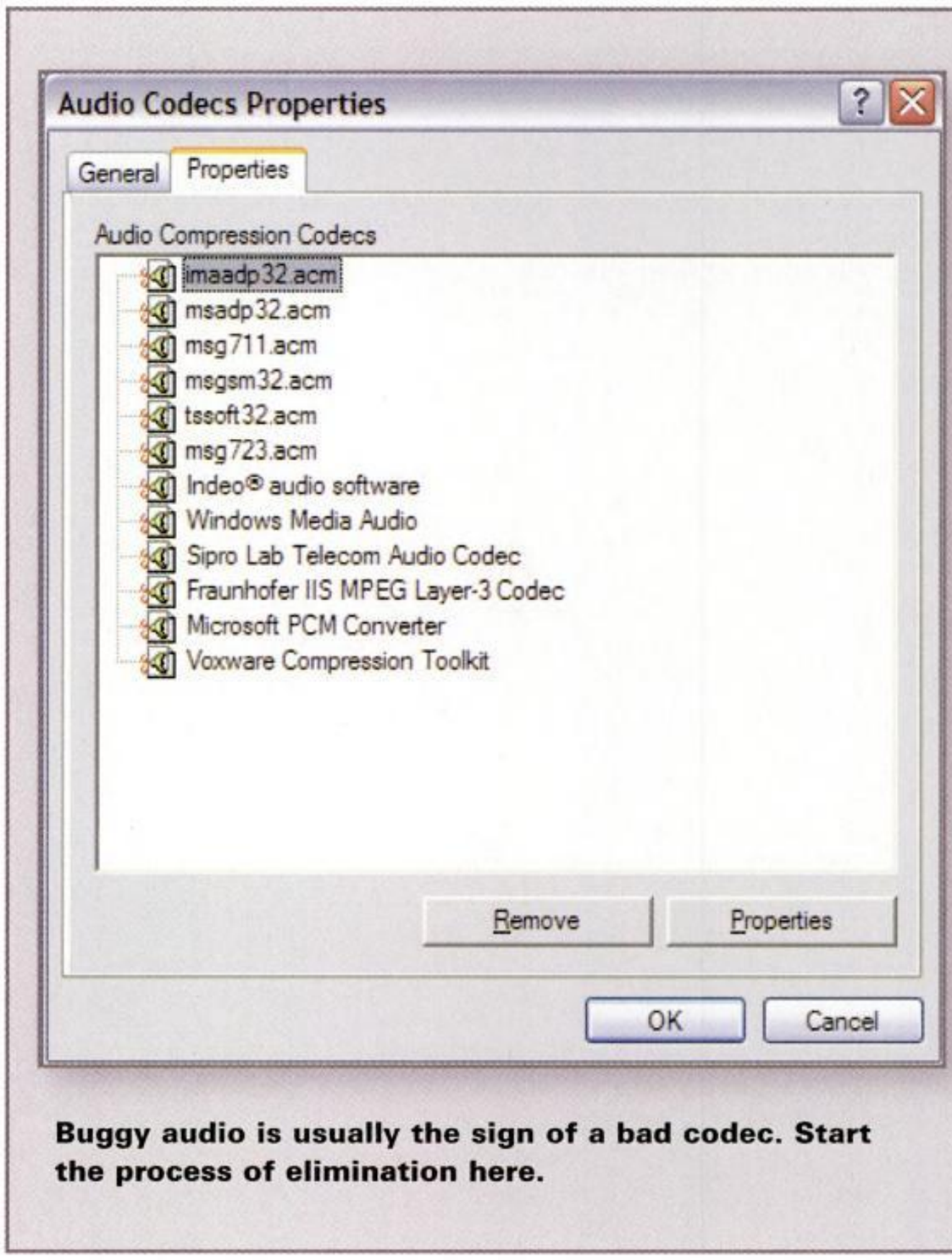
AUDIO AGGRAVATION

Sometimes my PC's audio suddenly begins to sound horribly distorted, but only under certain circumstances. For example, the audio during the introductory screens of games sounds like it's coming out of a garbage disposal, but the audio for the game itself is fine.

Different MP3 players have varying levels of CPU utilization. *Winamp* is an old favorite due to its low resource-consumption and wealth of features.

It sounds like you have a bad audio codec. A codec (short for "encoder/decoder") compresses audio and/or video so it will fit in a smaller space. Windows Media Video 9 is an example of a video codec, while MP3 is an example of an audio codec. If one or more of these codecs becomes corrupted, you'll get poor sound, poor video, or no sound or video at all.

Here's how to root out the offender in Windows XP: Right-click My Computer, select Properties, click the Hardware tab, and then click Device Manager. Within Device Manager, click the plus sign next to "Sound, video, and game controllers," double-click "Audio Codecs," then select the Properties tab. You'll see all the codecs installed in your system. Starting from the top, double-click each codec, and you'll get a dialog box that allows you to disable the codec. Disable it and test your sound with a file you know triggers distortion. If that doesn't solve the problem, re-enable the codec, and target the next one in line. Keep going until you've pinpointed the culpable codec. Once you've disabled the bad codec, write down its name, then try your test file again. Your sound may work fine, but if your media player says it can't find the right codec, enter the name in Google and find another source for a new or updated version of the same codec.



Buggy audio is usually the sign of a bad codec. Start the process of elimination here.

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SPEAKERS

Now hear this!

Back in the good old days, we were able test speakers in the *Maximum PC* lab during working hours. Not anymore. Today's PC audio systems are almost powerful enough to be measured not on a musical scale, but on the Richter scale. We're talking mega-wattage, earth-shaking bass, glass-shattering highs and surround sound so immersive you'll never go to a movie theater again. Of course, everyone has different needs (and space constraints), so luckily there are many different configurations of speakers available, from basic to bombastic.

First, almost all speaker systems include subwoofers these days—some with enormous 8-inch drivers—and most offer surround sound capability as well, including the recently announced 7.1 speaker systems from Creative Labs (that's eight speakers total!). Still, the most common speaker configuration these days is the 2.1 system, which translates to two satellites and a subwoofer. The satellites are the small speakers that go on your desk and reproduce the high and midrange tones, while the subwoofer tackles all the low tones and is usually placed under the desk somewhere. The phrase "2.1" refers to the two satellites, represented by the number "2," and one subwoofer, represented by the ".1." Using the same nomenclature, a 4.1 speaker system has—you guessed it—four satellites and a subwoofer. A 4.1 system is great for gaming because it includes a front and a rear channel, so you can hear enemies approaching behind you and watch the action in front of you at the same time. However, 4.1 leaves big audio gaps directly in front and behind you, which led speaker manufacturers to introduce 5.1 systems. These are now the de facto configuration for today's high-end PCs, mainly due to the fact that DVD movies are encoded in 5.1 surround sound, so a 5.1 speaker system is required to reproduce the movie theater experience. But that still isn't enough for the hardcore crowd, and thus 6.1 and 7.1 speaker systems have been launched as well.

Surround sound systems like Creative Labs' Gigaworks S750 bring new levels of immersion to the desktop.

Q How do "flat-panel" satellites work, and what are their pluses and minuses?

Some of the more interesting products on the PC audio landscape are flat-panel speakers, which are less than an inch thick and can even be hung on a wall like a portrait. Unlike traditional speakers, which use heavy magnets attached to cone-shaped drivers to create sound, flat-panel speakers employ what's called "planar magnetic technology." This design is like a magnetic sandwich, in which a conductive plastic diaphragm is the meat and two rows of magnets are the bread. Current is sent to the magnets from the amplifier, causing the diaphragm to vibrate, creating sound.

The benefits of flat-panel speakers are mainly aesthetic, in that they take up less space than traditional speakers and look very high-tech. They aren't all looks though, and actually offer surprisingly good sound quality. The only real downside to this technology is that flat-panel speakers tend to cost a bit more than regular speakers while not offering any significant performance or sound-quality advantage. If space is a concern, or if you like the sleek exteriors, flat-panel speakers are technologically sound. However, with so many superb "regular" speaker systems on the market, we have a hard time justifying the additional cost of them simply for their perceived "wow" factor.

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Tech Terms

All the specs and tech lingo explained

Crossover
A circuit that filters away audio signals that fall outside a certain range. This is used for preventing a speaker from receiving sound signals it cannot accurately reproduce. A crossover usually consists of one or more pairs of inductors and capacitors.

Dolby Digital
A Dolby Laboratories format for representing sound in six discrete channels—five positional channels and a subwoofer channel. This is a popular digital surround sound format, and is used in most DVD movies.

DTS Sound
Digital Theater System. A multi-channel surround sound format that competes with Dolby Digital and also delivers sound in discrete channels—five positional channels and a subwoofer channel. DTS movies are encoded at a higher bit rate than that used by Dolby Digital, so more information about the sound is used during recording (in other words, more bits of data are used).

Frequency Response
The frequency range within which the speaker will actually produce sound.

Mini-jack
The small audio connector frequently used by headphones and computer speakers. Sony invented the Mini-jack when it discovered that the large audio connectors used in the old days were unsuitable for portable audio applications.

Peak Power Rating (Burst)
The peak power a speaker can handle for a very brief period. This is usually higher than the RMS power rating.

Power Per Channel
The power rating of each individual speaker output.

RCA Plug
The traditional plug used in audio and video cables. RCA connectors are normally coded red for right-side audio, white for left-side audio, and yellow for video. RCA stands for Radio Corporation of America.

RMS Power Rating
Root Mean Square power rating. This is a speaker's maximum continuous power output, or how much power it can sustain indefinitely. This is a more accurate—and realistic—assessment of a speaker's power than Burst power (see item above).

Satellites
Speakers (usually small ones) that reproduce high and midrange tones, and that are designed for convenient placement.

S/PDIF
Sony/Phillips Digital Interface. A format for transferring digital audio data without first converting it to an analog signal. Generally, there are two kinds of S/PDIF connectors: one that accepts a coaxial RCA-type cable and one that uses an optic fiber TOSlink cable.

Subwoofer
A speaker designed to deliver very low-frequency sound. Because the human ear cannot distinguish the direction of very low-frequency sound, a subwoofer's placement does not affect the stereoscopic staging of music.

Surround Sound
The delivery of sound in more than two channels, with multiple speakers positioned in locations that "surround" the listener. The basic surround sound setup uses four speakers; two in front and two behind the listener.

THX Certification
A certification granted to theaters, home cinema and multimedia products indicating that they have met a level of quality deemed sufficient to faithfully re-create a movie theater experience. THX is essentially a quality label created by Lucasfilm, and was named after George Lucas's first feature film, *THX-1138*.

TOSlink/optical
A digital interface that uses a beam of light carried through a cable to transmit digital data to a speaker system. It uses a fiber optic cable, hence the name. It's sometimes referred to as TOSlink because it was developed by Toshiba.

2.1, 4.1, 5.1, and 6.1
Abbreviations used to denote the number of sound channels in a speaker system. The number before the decimal point indicates the number of regular audio channels and the number after the decimal point denotes the subwoofer (low-frequency) channel. For example, 5.1 means five regular channels and one subwoofer channel.

Since this Logitech Z-2200 system has two satellites and one subwoofer, it's designated as a 2.1 system. If it had two more satellites, it'd be a 4.1 system.

SPEAKERS Cheat Sheet

You've got questions, we've got answers

Question: What do I need to play movies in Dolby Digital surround sound?

A: In order to listen to true "discrete" Dolby Digital multi-channel audio on your PC, which is sound that is sent to separate channels from the sound source, all you need is a piece of hardware to decode the sound into its separate channels and a 5.1 speaker system. It's really that simple. A Dolby Digital audio stream is a digital signal that includes six audio channels, but these signals have to be sorted by a decoder and sent to their respective channels in order to get that movie-theater sound separation where you hear bullets whizzing from the front channel to the rear channel. This decoder can either be built into the soundcard or the speakers, or it can be a separate add-on unit.

In order to get discrete multi-channel audio, you'll need a Dolby Digital decoder like this sexy unit from Creative Labs.

Question: Does it matter where I place the subwoofer?

A: A subwoofer produces tones that are so deep the human ear is unable to pinpoint their location, which is why the conventional wisdom is to put the sub anywhere you like. Your ears can't tell the difference if it's three feet behind you or five feet to your right. However, there will always be a "sweet spot" in your listening area where the subwoofer sounds best, so we recommend playing a bass-heavy DVD (*Saving Private Ryan's* opening sequence is a good choice) or some thumping music and then moving the subwoofer around the room while returning to your listening area to see how it sounds. Once you've pinpointed the "sweet spot," invite your friends over to show your home theater off a bit! For tips on speaker placement, you also can read the article on the next page of this very issue.

A speaker system's subwoofer really lets you feel its power. For maximum impact, care should be taken in choosing its placement.

Question: How much power do I need?

A: A realistic assessment is that speaker systems that crank out 100 watts are sufficiently loud for home use, or 200 watts for a surround sound system. However, ultra-high-wattage speakers that are capable of 500 watts or more sound better at moderate volumes since there is absolutely no stress to the speaker's components at lower levels, whereas lesser speakers can become considerably stressed at lower volumes. The real reason for speakers to have high wattage ratings isn't to actually use those high levels of output, but to ensure distortion-free playback at lower volumes. As a yardstick, the 2.1 Logitech Z-2200 speakers are capable of pumping 200 continuous watts and are pure sonic fury. We almost went deaf testing them.

There is a wattage war going on right now, and Creative is winning with its 700-watt Gigaworks S750.

Question: I have a 5.1 speaker system, but am seeing advertisements for 6.1 and even 7.1 speaker systems now. Is it worth it to upgrade?

A: Although the addition of one little speaker behind you or two on the sides may not seem like it would make a big difference, it does. The traditional 5.1 surround sound speaker system sounds fantastic but leaves huge gaps in the sound field behind you and on the sides as well. The only catch to upgrading to 6.1 or 7.1 is that Creative Labs is the only manufacturer selling such speaker systems, but it offers both a budget 7.1 speaker system called the Inspire T7700 as well as high-end 6.1 and 7.1 systems as well (named Megaworks and Gigaworks). You can also buy Creative Labs' S700 5.1 system, which is upgradeable to 7.1 for an extra $100. Also note that you'll need a soundcard that supports 7.1 sound, but there are several models on the market currently that offer this feature.

6.1 and 7.1 speaker systems are all the rage these days, and are a fantastic upgrade from a 2.1 or 4.1 speaker system.

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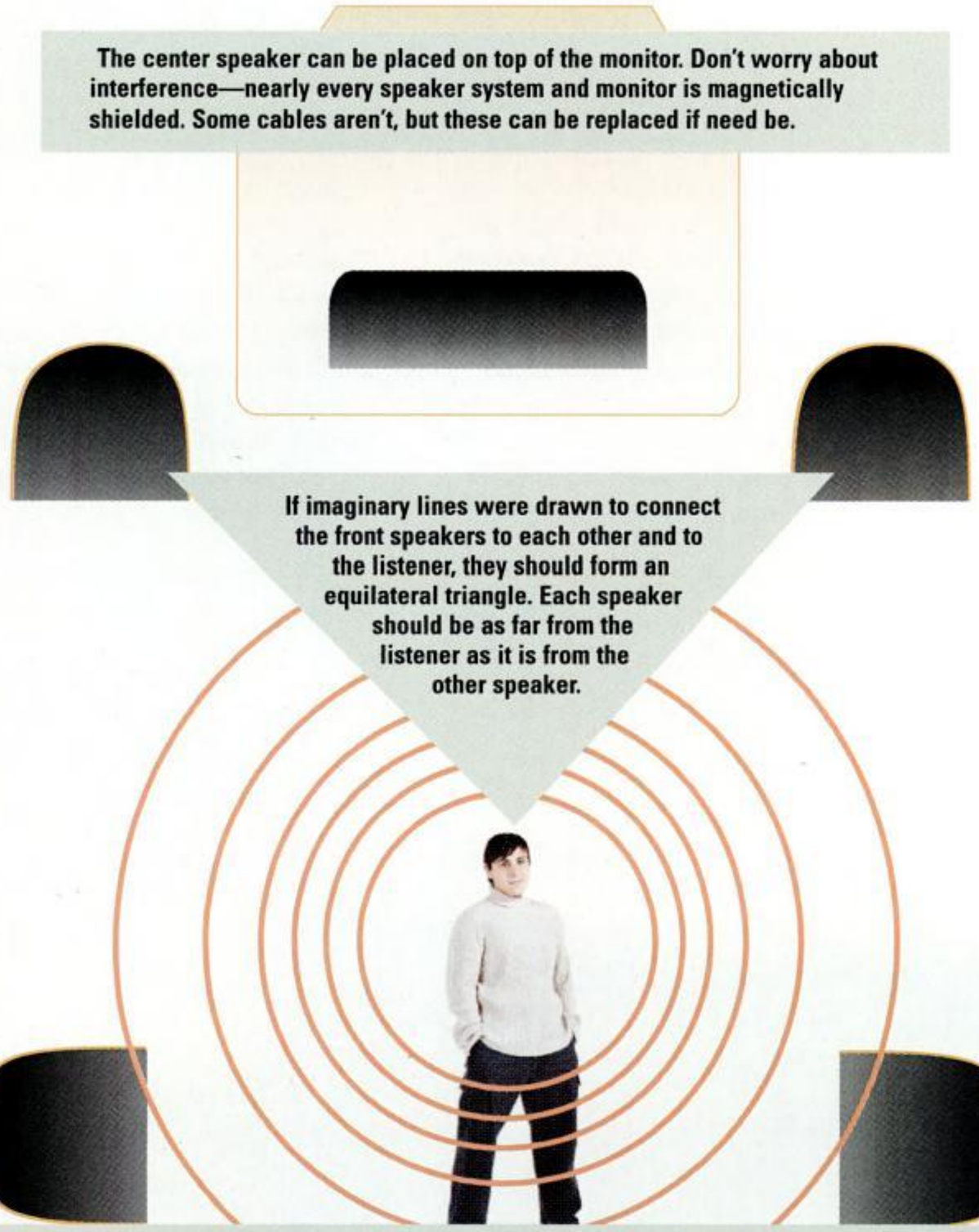
Putting your PC to work

SET UP YOUR Surround Sound SPEAKERS

5.1 Surround Sound: It's not just for home theater anymore!

Although it doesn't get the same press coverage as 3D graphics, 3D audio is rapidly becoming just as popular. Thanks to positional audio technologies, today's games can achieve a level of realism and immersion that simply was not possible prior to 3D audio. Dolby Digital surround sound also is becoming commonplace in PC games, and is the most common audio format for DVDs as well, meaning a set of 5.1 speakers isn't just an extravagant item anymore, but a necessity! However, in order to get the most from your 5.1 system, it's important to follow a few guidelines when setting them up in order to achieve maximum sonic impact.



The center speaker can be placed on top of the monitor. Don't worry about interference—nearly every speaker system and monitor is magnetically shielded. Some cables aren't, but these can be replaced if need be.

If imaginary lines were drawn to connect the front speakers to each other and to the listener, they should form an equilateral triangle. Each speaker should be as far from the listener as it is from the other speaker.

The rear speakers should be placed a few feet behind the listener, about the same distance apart as the front speakers, and they should be aimed at each other. Placing the rear speakers can be a challenge. Few speaker systems come with rear speaker stands, but if they don't you might consider building stands out of wood, or hanging the rear speakers from the ceiling.

Place the subwoofer in a nearby corner if posible, but also move it to a few locations to see which sounds best. If the speaker has an outward-facing driver, point it toward the listening area.

Wall Mounting

You also might consider mounting speakers to the walls around your desk. Most speaker systems come with stands for the satellites, and, in some cases, the stands convert into wall mounts (such as with the Logitech Z-5300). For those that don't, you might consider building small shelves. It's a simple project that can be accomplished with store-bought goods or a pre-fabbed shelf from Home Depot. Also, remember that if you can't place the rear speakers in the exact spot you'd like, most soundcards let you tweak the volumes of each speaker or pair in order to obtain an ideal listening experience.

Time to Tweak

Once you have your speakers in place, drop in a movie with a notoriously excellent surround sound sequence and try moving the satellites and sub around to note the differences. Perhaps the sub sounds better in the corner vs. underneath the TV stand. Or maybe the rear channels need to be a little further back, or facing toward a wall rather than toward your ear. Every room is different, so play around with different settings and stick with the config that sounds best to your ears!

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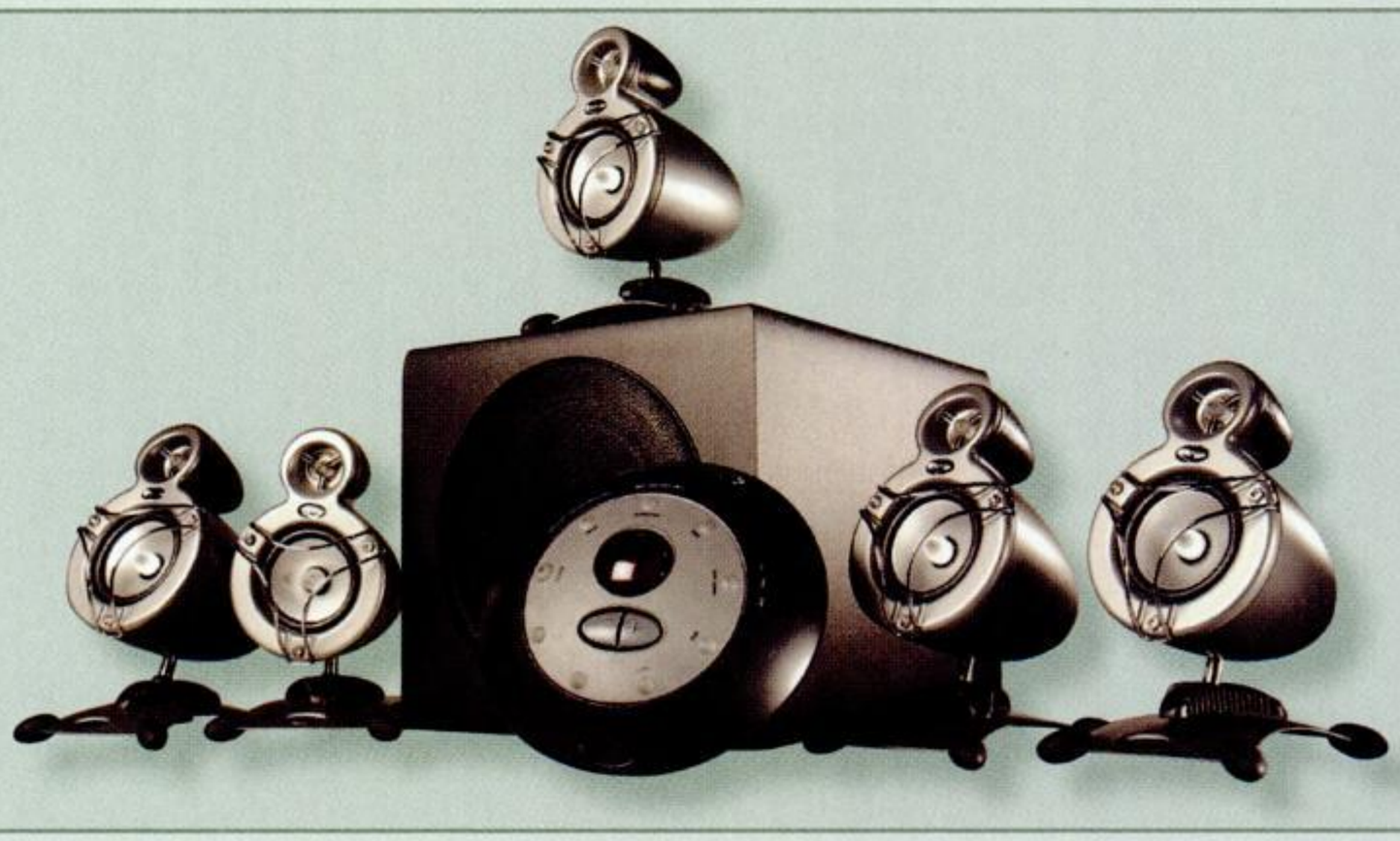
Ask the Doctor

Your PC is sick, we've got the cure



We're big fans of Klipsch speakers, but stay away from its GMX series of speakers (above)—they're strictly for consoles.

SPEAKERS FROM SPACE

I bought the Klipsch GMX speakers and have a Soundblaster Live. How can I get 5.1 sound out of them?

The new Klipsch GMX-D5.1s were designed primarily for console gamers and include only digital 5.1 support. For PC gamers, this setup sucks, because most soundcards can send only a two-channel PCM signal digitally. If you want to get 5.1 sound out of your GMX-D5.1s, you'll need an nForce motherboard or a soundcard that can output a Dolby Digital 5.1 stream. Unfortunately, only the Sound Blaster Audigy and Audigy 2 products can do that now. Your GMX-D5.1s are essentially 2.0 speakers, unless you have a properly outfitted soundcard.

WORRYING ABOUT WIRES

What is the best way to lengthen speaker wires that are hard-wired into the back of the satellite?

The only way to deal with this tricky situation is to don your electrician cap and splice an extra length of wire into the main speaker wire. Grab a set of wire clippers/strippers and clip the wire at any point. Next, strip the cabling off the leading edge of the wires to expose the internal wires and connect the two sections of cable. Twist the new wires together and wrap the exposed portions of wire (the parts that used to be covered in cable sheath but are now entwined) with electrical tape and you're done.

GOING COMMANDO

Is it OK to remove the dust covers from my speakers? I like the look of the drivers and want to show them off!

It's totally fine to remove the dust covers from your speakers. After all, that's all they are—covers to keep dust off the drivers. In fact, some people like the look of the speaker drivers as opposed to the speaker grills, but to each his own. Be warned, though, that removing the safety covers exposes your speakers to errant flying objects, mischievous kitty cats and all sorts of desktop dangers. Personally, we like to protect our PC hardware, so we'd leave 'em on.

DIGITAL VS. ANALOG

I hear a lot about digital vs. analog speakers. What's the diff?

When people talk about "analog" vs. "digital" speakers, they usually are referring to the speakers' connectors, not the speakers themselves. Some speakers only have analog connectors, while some only have digital connectors. The best speakers have both! The difference between them is that PC games typically require analog connections, whereas DVD movies require digital connections. Most big-ticket surround sound speaker systems include only analog connectors, but Logitech's all-conquering Z-680 speakers include both types of connectors, which is why they've earned a 10 verdict from us, as well as a Gear of the Year award—twice!

While most surround sound speaker systems allow only analog output, Logitech's awesome Z-680 can handle both digital and analog output.

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CRTs & LCDs

Do you prefer perfectly flat or totally fat?

If you think Hell is a 640x480 VGA monitor, just remember that the very first PC displays couldn't show full-color images whatsoever—we just had green text on a black background, and we loved it! The display currently gracing your desk is a work of art compared to the very first monitors, for it gives you a clear picture of your digital world—every mouse move, every keystroke, every pop-up window, every confirmed frag.

Because they're built to last, modern full-color monitors have a delightfully long life in an age of disposable CPUs. And because their job is simply to show you the information outputted by your videocard, your monitor is blissfully uninterested in being upgraded to keep pace with your motherboard, memory, hard drive, and so on. Also, because Cathode Ray Tubes (CRTs) in particular typically weigh close to a metric ton, they are expensive to ship and a pain to get home in your Toyota Prius. So there's a lot of built-in incentive to buy a display you'll be happy with for a long, long time.

However, like a "life partner" who's been packing on the pounds lately, it's sometimes hard to notice that a monitor has outlived its best years until you spy something better. Indeed, while all CRT and LCD technologies work on the same basic engineering principles, the technologies have indeed improved over the years, and displays engineered in the 1990s just don't look as good as their modern counterparts. The rest of the world might be passing you by with higher resolutions and better color accuracy, and the urge to upgrade becomes irresistible.

There are plenty of good reasons to upgrade your display, but don't deep-six your current display for the flavor of the month without understanding more about the two types of monitors.

The arrival of super sexy LCDs has sounded the death knell for the beloved CRT.

Q What is a CRT?

The term stands for Cathode Ray Tube. CRT monitors are just fancy implementations of the same technology used in common TV sets: An electron beam originating from the base of a vacuum-sealed tube scans across the tube's screen, which is covered with a layer of phosphor material. A metal grating or wire mesh limits how much of the electron beam can hit individual phosphor clusters, thus leading to an acceptably sharp image. When the phosphor material becomes excited, it glows either red, green or blue. Mix up several differently colored phosphor clusters (pixels by any other name), and suddenly you have millions of colors. Although it is possible to make flat or nearly flat cathode ray tubes, most older models exhibit some curvature, at least around the corners. Most flat CRTs are based on aperture grille technology, but some use shadow-mask technology (both are explained on the next page).

Q What is a LCD?

Liquid-Crystal Displays are modern alternatives to CRTs. LCD manufacturing starts with a flat pane of glass, which is then layered with a grid of small transistors; the transistors are arranged in groups of three, and each triad describes a screen pixel. When excited by electricity, these transistors can be made to open and shut. Put a backlight behind the transistor grid and, behold, you have an image. Well, that's the shamefully simplistic version of how LCDs work, but it should be enough to give you the basic concept.

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CRTs & LCDs Tech Terms

All the specs and tech lingo explained

Aperture Grille
A type of CRT that uses a grille of extremely fine wires to focus the electron beam precisely on the right phosphor clusters. Sony introduced this technology with its Trinitron line of displays. An Aperture Grille-based screen typically displays more vivid and brighter colors than a Shadow Mask display.

This aperture "grille" is thrashed, but we can still see the vertical phosphor stripes that determine how much light hits the display.

Brightness
This spec is simply a measurement of how brightly a monitor can display its images. It is often expressed in candelas per square inch: cd/in².

CRT
Cathode Ray Tube. A traditional monitor and TV screen technology that produces a picture by using an electron beam to excite phosphors behind a glass screen.

Dot Pitch
The distance between each individually colored phosphor dot on a Shadow Mask CRT screen. A smaller dot pitch allows for a sharper image. Dot pitch is usually measured in millimeters. For example, a pitch of 0.28mm isn't as sharp as a pitch of 0.25mm.

Grille Pitch
The distance between individually colored phosphor stripes on an Aperture Grille screen. A smaller pitch allows for a sharper image. Like dot pitch, grille pitch is also measured in millimeters, and smaller pitch numbers are better.

LCD
Liquid Crystal Display. The main advantage of LCD screens is that they can be made very slim, and are always perfectly flat. Unfortunately, unlike CRTs, LCDs have only one native resolution, and can look distorted when running non-native resolutions.

Pixel Pitch
The size of each colored pixel on an LCD or plasma display.

Pixel Response
The time required for an LCD pixel to change color. A slow response time can lead to blurriness during video playback and 3D gaming. CRTs do not suffer this particular brand of blurriness.

Refresh Rate
The number of times a CRT's electron beam sweeps across the screen during a full second. Refresh rate is measured in kilohertz (Hz), with the lowest acceptable value being 75Hz. (Any rate lower can cause eyestrain.)

Shadow Mask
A metal sieve placed behind a CRT display to ensure that the display's electron beam hits precisely the right phosphor dots. A Shadow Mask CRT is typically bulbous in shape.

Viewing Area
The portion of a display that can actually show image content; typically expressed in inches, and measured from one corner of a screen to the diagonally opposite corner.

Display Resolution
The number of pixels a monitor can display. Resolution is usually expressed in the form of a horizontal value followed by vertical value. For example, a resolution of 1280x1024 means that the monitor can display 1280 pixels horizontally and 1024 pixels vertically—1,310,720 total pixels.

Your display's resolution is the number of pixels that appear on the screen. More pixels equals a sharper image, whereas a lower resolution will appear blurry and dithered.

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CRTs & LCDs Cheat Sheet

You've got questions, we've got answers

The 19-inch CRT is starting to look like a product of a bygone era, what with affordable 21-inch CRTs now the norm.

Q: What type of display is the best for gaming?

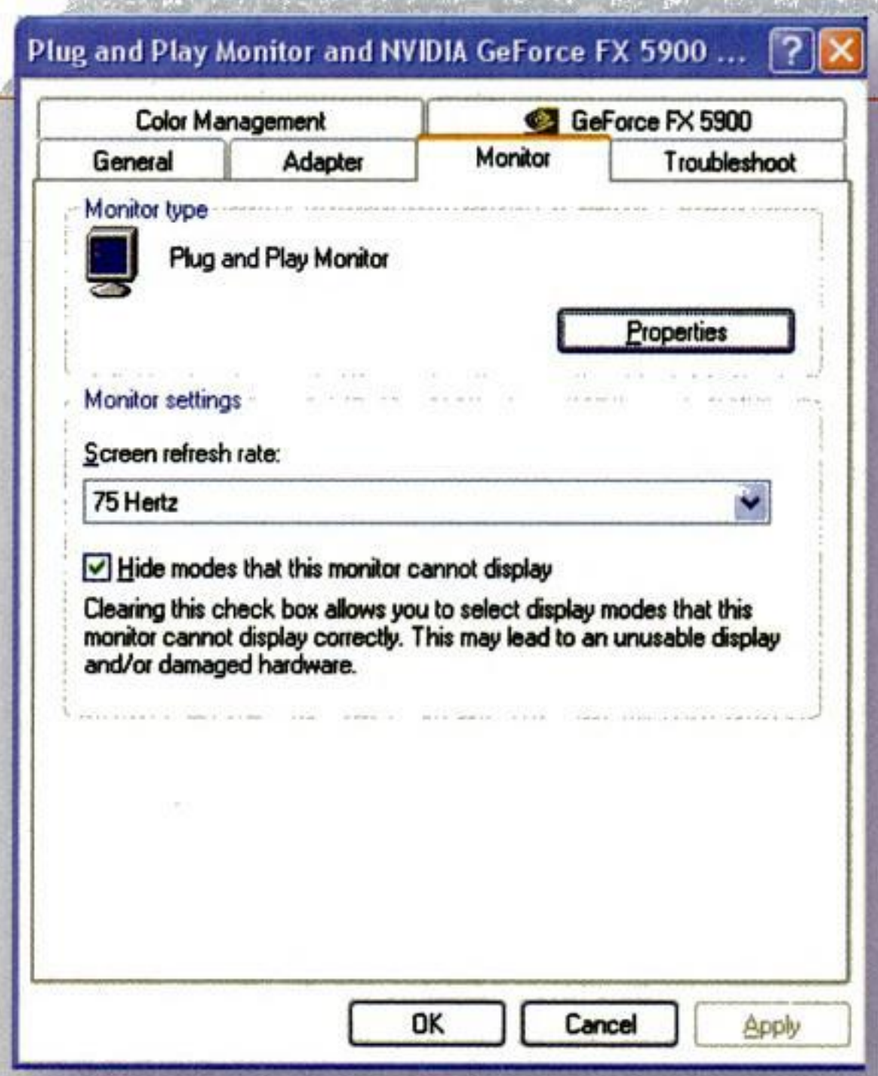
A: The knee-jerk recommendation has long been "a primo 19-inch CRT." Why? Because CRTs are better suited for gaming than LCDs (they offer better color accuracy as well as support for multiple resolutions without visual-quality degradation), and because 19-inchers have always been great values, price-wise. However, in today's modern age of affordable 21-inch CRTs, we say the bigger the better—unless, of course, you need to transport your display to LAN parties. If that's the case, then an LCD with a proven, fast pixel response time might make sense. Just be aware that if you try to run the LCD at a non-native resolution, your screen content might look a bit jaggy and blurry.

Q: What is an optimal refresh rate?

A: On an LCD, this is a no-brainer—use whatever refresh rate the manufacturer tells you to use for the native resolution of the panel (this is the resolution the display *has* to run at in order for everything to look normal, i.e., not stretched out, squished, or jaggy). This is almost always 60Hz, even if the monitor may be able to handle higher. Don't worry—LCD pixels don't fade and strobe the way CRT pixels do, so 60Hz won't cause eyestrain.

CRTs are a little trickier. While some would answer "as high as a resolution as the CRT will allow," we recommend taking a more cautious approach. First, make sure you've loaded the Windows drivers for your particular display before you mess with the refresh rate settings. With the driver loaded, Windows won't let you choose a rate higher than the monitor can display without damage to its circuitry. Our advice is to stay away from 60Hz, but 75Hz or higher will be just dandy.

A monitor's refresh rate is the number of times the on-screen image is updated every second. The key is to set it high enough that you don't notice the flickering.



A high-end aperture grill CRT offers the perfectly flat screen of an LCD with the resolution range needed for gaming.

Q: What is the benefit of an Aperture Grille CRT over a Shadow Mask CRT?

A: Shadow mask CRTs can have bulbous screens, which is a by-product of their basic design—the screens of older models must be curved a bit for proper electron beam deflection. Also, the core masking technology that makes shadow mask CRTs different from aperture grille CRTs allows for relatively fewer electrons to hit the phosphor layer. This, in turn, leads to relatively dimmer screens and less brilliant colors than what one might find in an aperture grille display.

Aperture grille CRTs are generally considered finer pieces of technology, and, indeed, most CRTs intended for high-end image editing and design work are aperture grille displays. The best aperture grille monitors offer perfectly flat, non-bulbous screens, and this reduces glare from ambient light. And, as noted earlier, the aperture grille allows for more electrons to hit the phosphor layer, and this allows for brighter screen content and more brilliant colors. Aperture grille isn't perfect technology, however. The grille itself is held in place by two very thin wires, which can be manifested as two extremely thin lines crossing the screen horizontally. These wires can be distracting if you're the obsessive-compulsive type.

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CHOOSE A CRT Monitor

The right CRT for you

There are many factors to consider when buying a CRT monitor. High-end CRTs cost an arm and a leg. Budget CRTs will give you headaches. Here's how to find a happy medium.

Screen Size and Resolution

The first decision point is picking a screen size. Sizes are generally specified by the diagonal size of the CRT tube. The most common are 17", 19", and 21", with a 4:3 Aspect Ratio, which specifies the width vs. the height of the screen. Note that the viewable part of the screen inside the monitor bezel is generally about one inch less than the tube size. Pay attention to the "viewable" size, since it's the part you actually see. If you can afford it, bigger is generally better, but too large a screen may cause eyestrain, so try several out for size before you buy. In general, we steer clear of 17" monitors (too small) and 24" monitors (too big), so 19" or 21" is the sweet spot. One of the great advantages of CRTs is that they perform well over a wide range of resolutions, but for optimum image quality, you should aim for the following:

17"	1024 x 768	to	1152 x 864
19"	1152 x 864	to	1280 x 1024
21"	1280 x 1024	to	1600 x 1200

Connectors

All CRT monitors come with a VGA-style DB-15 connector. Some high-end monitors also include five BNC connectors for individual RGBHV connections. These are recommended if you're running cable lengths over 15 feet.

Shadow Mask or Aperture Grille

There are two common types of CRT tubes: Shadow Mask and Aperture Grille. Shadow Mask tubes have a screen made up of round red, green, and blue phosphor dots. Aperture Grille tubes have alternating vertical stripes of red, green, and blue phosphors. Which type is better? They're both suitable for most applications, but there are differences. Shadow Mask tubes can show finer detail, but they also tend to produce stronger Moiré interference patterns on-screen (which look like rainbow colored swirls). Aperture Grille tubes generally produce images that are brighter and higher in contrast, with colors that are somewhat more vibrant and saturated, but they tend to be more expensive. They also include two very fine horizontal damper wires that are generally invisible to most users but that drive others crazy.

Dot Pitch or Slot Pitch describes the spacing between the RGB phosphors in millimeters. In general, the smaller the better, but this spec is much-abused and misunderstood, so always take this spec with a grain of salt. Note that you can't compare the pitch values between Shadow Mask and Aperture Grille tubes since they are completely different. In fact, you shouldn't compare the pitch values between different manufacturers or tube designs.

Flat or Curved Screen and Anti-Reflection Coating

The natural shape of all CRT monitors is curved, but they are now manufactured in flat versions at somewhat higher cost. Flat screens are better because they minimize visual distortions and glare. However, the flatter the tube, the more likely there will be some geometric distortion and reduction in sharpness, particularly in the corners. When viewing a "perfectly flat" CRT at the computer store, pay close attention to the corners of the display to determine if the distortion levels are acceptable to you.

You'll also want to make sure a CRT has an anti-reflection coating, because without it, you'll see a mirror image of everything in front of the CRT, including yourself and everything behind you. Not only is this distracting, but it significantly reduces the contrast and readability of the screen. Anti-reflection coatings range from the cheap and relatively ineffective frosting (which also reduces image sharpness) to dielectric layers like those on high-quality lenses. If you work in a relatively darkened room, anti-reflection will be much less important than if you work in a brightly lit environment.

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CHOOSE A LCD Monitor

The right LCD for you

Just like with a CRT, the first decision point is picking a screen size. Sizes are generally specified by the diagonal size of the screen. The most common are 15", 17", 18", 19", and 20", with a 4:3 or 5:4 Aspect Ratio, which specifies the width vs. height of the screen.

The most important point to be aware of is that each LCD is manufactured with a fixed pixel resolution format, called its "Native Resolution." You need to use the LCD in its native resolution; otherwise there will be a substantial and generally unacceptable degradation in image quality. That's because the LCD must internally convert other resolutions into its native format in a process is called "rescaling," which always degrades the image, especially when there is text and graphics.

The native resolution varies with screen size.
Typical values are:

15"	1024 x 768
17"- 19"	1280 x 1024
21"	1600 x 1200

Response Time and Motion Artifacts

LCDs also have a relatively slow response time compared with CRTs, and they suffer from varying degrees of motion-smear, motion-flicker, and other motion artifacts. Most panels include a response-time specification in milliseconds. In general, the smaller the better, but this spec is "spun" by manufacturers sometimes, so be cautious. Some manufacturers quote separate (and smaller) rise and fall times. Also, the times refer to transitions from peak white to black, whereas the more common gray-gray transitions are much slower. The faster panels generally show greater motion-flicker, which is often more of a visual problem than motion-smear. To check on the degree of motion-flicker, go to www.displaymate.com/dwshots.html. Slowly and smoothly move the scrollbar up and down. Look for flicker in any of the test patterns and in the navigation bar text in the on the left side of the screen.

In order to minimize additional motion artifacts, make sure that you set your refresh rate to the native refresh rate of the panel, which generally is 60Hz. This should be in the monitor's spec sheet. Setting it to a different value (particularly a higher value like 75Hz) will reduce image quality in analog mode and may introduce strobing effects and some image break-up when there is motion.

Analog or Digital

Most LCDs are connected to the computer via the same analog VGA DB-15 connector as CRTs. That makes them an easy replacement for CRT monitors. However, LCDs operate at a fixed pixel-resolution format, so the monitor must analyze the analog signal and try to extract and measure each individual pixel in the image. That's easier said than done, and if it's not done exactly right, the LCD image actually will appear a bit fuzzy and include some digital noise as well. Some LCD monitors also include a digital or DVI interface that transmits the signal to the monitor digitally, which largely solves this dilemma. Monitors with DVI inputs are more expensive, though, and you'll need a graphics board that has a DVI output and connector.

Image Quality Issues

LCDs can have outstanding image and picture quality. When properly adjusted, they can produce a perfectly sharp image, something that is beyond the capability of a CRT. But there are some areas where LCD performance may be weak: They have trouble producing pitch-black and usually produce some level of dark-gray instead, and they may have trouble reproducing intensities near peak white (called "white saturation") . The gray-scale may be uneven, with irregularities and bumps, particularly at low intensities, and the Gamma may be way off, resulting in color-calibration errors, that can affect digital photographs. The *DisplayMate* test patterns (on the disc included with this magazine) will let you check and evaluate all of these issues.

PERFORMANCE ISSUES AND DISPLAYMATE

There are considerable differences in performance between different monitors. Even if you know what to look for, it's hard to make a decision without the right tools and test patterns. *DisplayMate* is the computer industry standard for testing and evaluating monitors. *Maximum PC* uses the advanced *DisplayMate Multimedia* Edition for testing and reviewing all of the magazine's monitors. There are also end-user versions, designed to help users set up and tune up their monitors for optimal image and picture quality. They are also very good for monitor testing and evaluation. In addition, DisplayMate and *Maximum PC* are making available a free limited-function demo version of *DisplayMate*, with six sample test patterns to help you get started. Use them to perform some basic tests on any monitor you're thinking about buying. It's available on the disc as well as the magazine's website, www.maximumpc.com.

Restricted Material

Ask the Doctor

Your PC is sick, we've got the cure

CABLE QUERY

If I upgrade from a CRT to an LCD, do I need to upgrade my videocard as well? Will there be any issues connecting my current videocard to my new display?

It depends on your hardware, but probably not. The standard connection for a CRT is an analog DB-15 cable, and most LCDs include this type of connector. However, some LCDs are capable of sending a digital signal, so they use a DVI (Digital Visual Interface) connector. In order to use this type of connector, it must be supported on your graphics card. Luckily, most modern videocards sport both types of connectors.

OUCH...MY HEAD!

I have a CRT monitor, and sometimes, after using the computer for a while, I get headaches. Is this normal?

Headaches are a common side effect of an improperly set up workstation, but there are a few things you can do to mitigate the effects. The first thing you should do is to make sure your monitor's refresh rate is set to a proper level. If it's set too low, the screen will appear to be flickering and will give you a headache in no time. Once the monitor is set to a higher refresh rate, the screen will flicker so fast that it will largely be imperceptible, which will alleviate the problem. To change your refresh settings, right-click the desktop and select Properties, then click on the Settings tab. Next, click on the Advanced tab in the lower right-hand corner and then click on Monitor. Your refresh rate will be displayed in this screen, so simply change it to the highest setting possible.

It's also wise to make sure there is adequate light in your work area. Some people like to work in the dark because it makes the images on the screen seem more vivid. But it's common knowledge that this will hurt your eyes over time, and will definitely contribute to headaches as well.

Finally, be sure to take breaks. As a general rule, you should take a break every half-hour. Close your eyes, roll your neck around, and don't look at a computer screen for a few minutes if possible.

The standard display connection is this DB-15 cable, which can be used for both CRT and LCD displays.

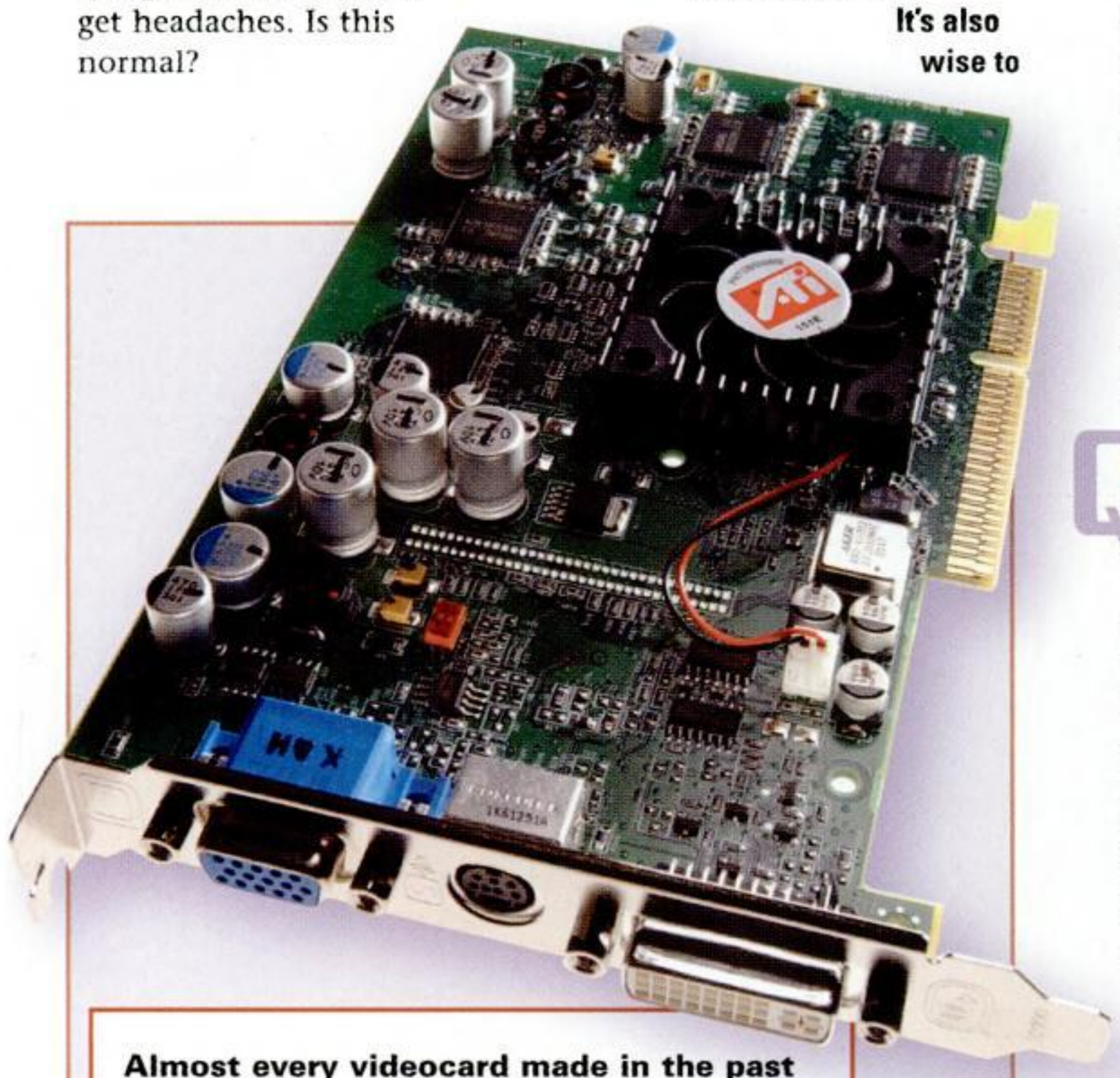
IS DUAL DISPLAY OK?

What do I need in order to run dual displays?

Well, besides two displays, you need either a videocard with dual outputs or two physical videocards. Luckily, most mid-range to high-end videocards released in the last few years have included both an analog DB-15 connector as well as a DVI connector for an LCD. If you have one of these videocards and want to run two LCDs, you'll have to acquire a DVI to DB-15 adapter, which are available at Radio Shack.

If your videocard only has one output, you'll have to run the second display from a second physical videocard. Dual-displays are supported in Windows XP, so as soon as you plug in the second display XP will recognize it and allow you to set its resolution from the Display Settings menu (right-click on the desktop and select Properties, then Settings).

If you're concerned about gaming issues with dual-displays, remember that when you fire up a game it will automatically run on the gaming card and be displayed on one monitor, so the secondary display will just be for desktop work.



Almost every videocard made in the past few years is suitable for dual-displays thanks to its dual-outputs. The round port between the DVI and DB-15 ports is a TV-Out jack.

This VGA to DVI adapter lets you plug a standard DB-15 monitor cable into a videocard's DVI-out jack.

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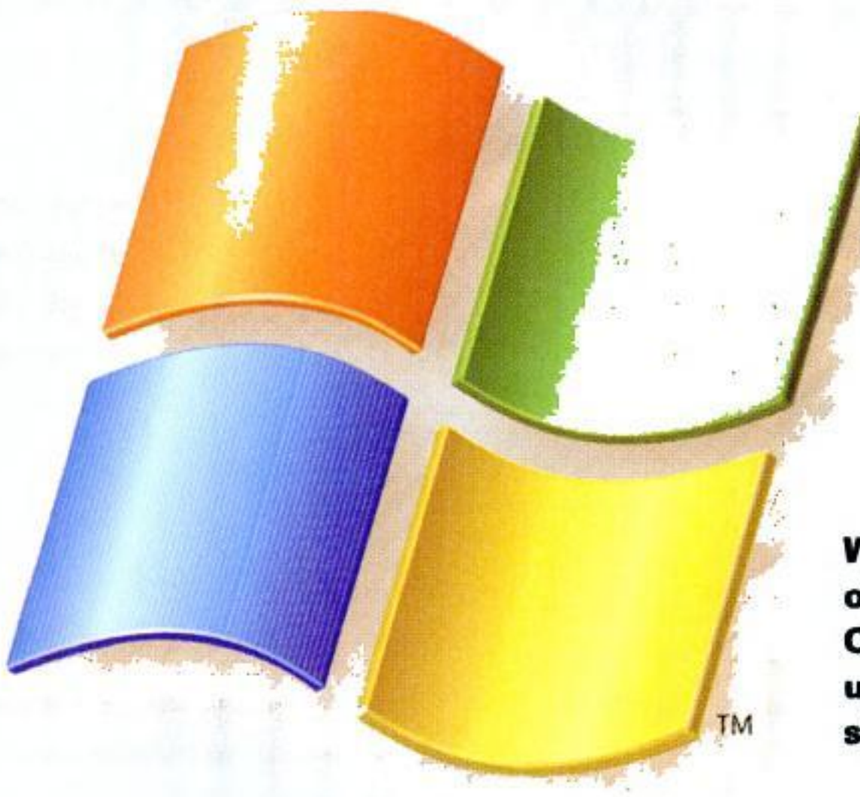
WINDOWS XP.

Delving deep into your PC's most important software!

For many years, Microsoft has offered two distinct operating systems: An extremely stable and secure OS for the corporate crowd called Windows NT (and, later, Windows 2000), and an easy-to-use, multimedia-ready version for the average consumer, known as the Windows 9x series. But wouldn't it be great to have the stability of Windows NT along with the user-friendly nature of Windows 9x? This is the promise of Windows XP, which is built on the NT kernel (or code base), yet has all of the user-friendly features of the 9x series—and then some.

The Frankenstein approach of melding the two disparate operating systems has largely worked for Microsoft, as XP is bedrock-stable and loaded with so many cool features we almost don't know where to begin. Everything from setting up a home network to burning CDs and emailing pics to mom has been streamlined and made into an intuitive, easy task. Even rudimentary tasks, such as "Copy this file, burn it to a CD," are now integrated into the dialog boxes for viewing files. And if other people want to use your PC, they can set up their own password-protected account and have all their own folders, settings, and files. Setting up networks and Internet connections is also a walk in the park. So much so that, in some situations, it merely involves connecting the PCs. XP does the rest.

All in all, XP is the bee's knees. It will remain the de facto PC operating system for at least another two years, or as long as is takes for its successor—codenamed "Longhorn"—to arrive.



Windows XP is easily our favorite Microsoft OS ever. If you haven't upgraded yet, you should.

Q What features will be in Microsoft's next operating system?

The next version of Windows is due in the year 2006 (we hope), and is codenamed "Longhorn." Although the underlying code of Longhorn will be very similar to that used in XP, it will look and feel totally different. First off, there's a simple pleasure: a clock on the Welcome screen (in which you choose your user account). Shared PCs often show this screen when nobody's using them, so the addition of a clock is a nice little convenience.

Speaking of clocks, one of the biggest additions to Longhorn is the "sidebar", a vertical bar that runs from the top of the screen to the bottom and can be docked to either side of the desktop. The sidebar is meant to be an all-in-one starting point for your workday, sort of like a Quick Launch bar on steroids. It features a large, 3D clock, and lets you dock almost anything you like, including *IM* contacts, news tickers, a text box to search the Internet and, of course, quick start icons. It even can be made transparent so that you can see your desktop through it.

Longhorn also strives to provide the user with more information about his or her computer. One example of this is in "My Computer," where each drive listed shows how much free space it has left via a progress bar, and folders full of images or music display a wealth of information about each individual file.

The Longhorn task panel, which appears in the left side of Windows Explorer windows, contains more tasks than it does in XP, including one-touch shortcuts for renaming files, copying files, moving files, publishing files on the Web. It also includes a text box to help you search the computer's storage system for files and folders.

Features likely will come and go as Longhorn evolves from its current form to its final-release iteration, so take all of the above with a grain of salt.

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WINDOWS XP Tech Terms

All the specs and tech lingo explained

Backup Wizard
A software feature available in the Pro version of XP that allows the user to back up and restore files on the computer. The backup wizard can be accessed by clicking Start->Accessories->System Tools->Backup.

Blue Screen of Death
A blue screen with white text that is frequently displayed when Windows crashes.

Control Panel
A software program that allows the user to determine various settings on the computer. Control panel can be reached by clicking Start->Control Panel.

Desktop
The starting point and "home base" for people using Windows. The desktop works like a virtual real-world desktop, letting you store frequently accessed files and programs on it for quick access.

Device Manager
A software feature that allows the user to inspect and alter the properties of all devices attached to the computer. Device Manager can be accessed via the system applet in the control panel under Windows XP.

File and Settings Transfer Wizard
A software program that allows the user to easily transfer files and settings from one computer to another. The file and settings transfer wizard can be accessed by clicking Start->Accessories->System Tools->File and Settings Transfer Wizard.

HAL
Hardware Abstraction Layer. A layer of programming that lets the operating system interface with a system's hardware at a general or abstract level, as opposed to at a detailed hardware level. The benefit is that this allows programs to run on a wide range of hardware without suffering incompatibilities.

One of windows XP's most useful features is the bundled Internet Connection firewall.

Internet Connection Firewall
The software in Windows XP that is used to protect your PC from hacking. The firewall is a software program that sits between your PC and the Internet. Whenever a request arrives to either receive or send data, the firewall decides if it should let the request through based on whether it's a legitimate request or an obvious hacking attempt.

NTFS
New Technology File System. A newer file system supported by Windows NT, Windows 2000, and Windows XP that replaces the older FAT16 and FAT32 file systems used in the Windows 9x series of operating systems. It's more secure because it allows user-level access to files to be controlled by an administrator.

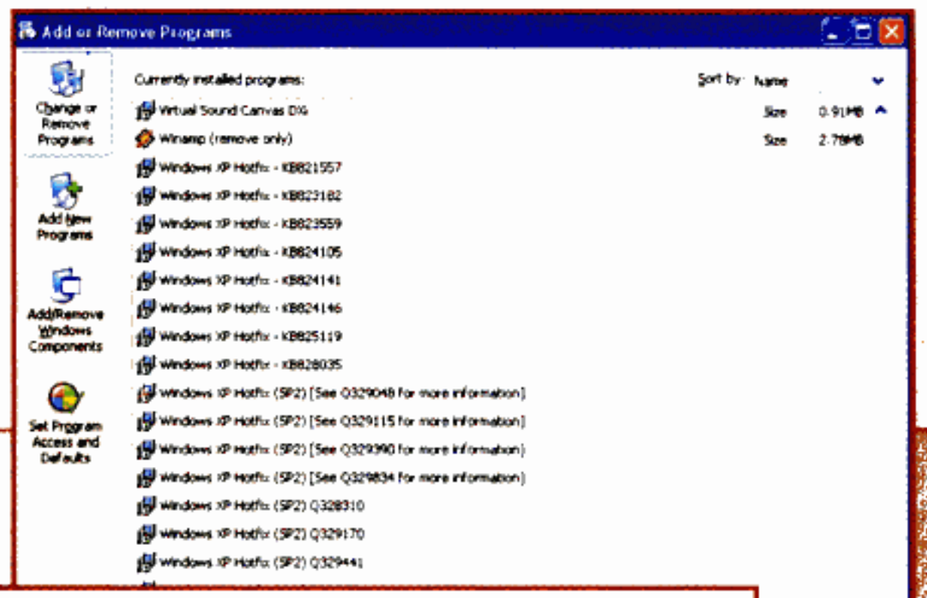
Recovery Console
A software program included on the Windows installation CD-ROM that allows the user to gain direct access to the file system without starting the graphical user interface. The recovery console can be accessed by booting from the Windows CD and hitting F10 at the welcome screen, then pressing R.

System Restore
A feature found on newer versions of the Windows operating systems that allows the user to revert the computer back to an earlier point in time.

Task Manager
A software feature that allows the user to list, and, if necessary, shut down applications and processes that are currently running. The Task Manager can be accessed by hitting Ctrl-Alt-Delete on Windows XP.

User Profiles
A software feature that allows multiple users to use the same computer while maintaining individual settings, files, and appearance for each user.

Windows Activation
An anti-piracy measure instituted by Microsoft that requires users to "activate" each copy of Windows XP via a communication with Microsoft. During activation, Microsoft notes your computer's hardware configuration and ties it to the activation number, which prevents people from installing their copy of XP on multiple machines.



Microsoft releases lots of little patches called "hotfixes" for its operating systems.

Hotfix
An urgently needed update or patch for a software program or operating system. Microsoft bundles large, operating system-wide changes into its Service Packs, but fixes little things in between these major overhauls with "hotfixes."

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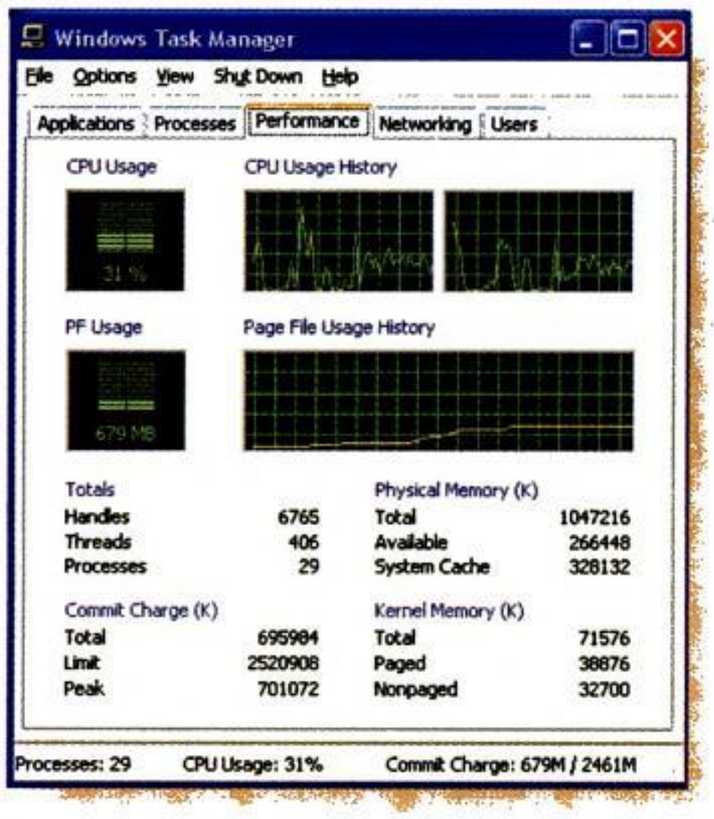
WINDOWS XP Cheat Sheet

You've got questions, we've got answers



The Task Manager lets you know what's happening behind the scenes, including how much memory is being used and what kind of load your CPU is under.

Q: How do I monitor what XP is doing?

A: Via Window XP's Task Manager, a handy little applet invoked by the "three-fingered salute," otherwise known as pressing Ctrl, Alt, and Delete simultaneously.

The most common reason to invoke the Task Manger is to shut down applications that have stopped responding, which show up in the Applications window as "Not Responding." You simply highlight the hung program and click "End Task" to shut it down. Windows XP has an amazing ability to recover from frozen applications, and ending them in this window rarely results in any further trouble.

The next tab, Processes, displays the processes that are currently running. You can selectively end any process, but we don't recommend dabbling in this area unless you know what you are doing. It's sort of like flipping switches on an unfamiliar control panel, and is best left to advanced users. The Performance tab shows graphs of CPU and memory usage, which will tell you whether you've run out of memory or have plenty left to fill up. The Networking tab shows the network utilization of each network adapter that's active in the system. Finally, the Users tab shows information about the various users of the PC. Here, each user can be disconnected from the system or logged off completely.

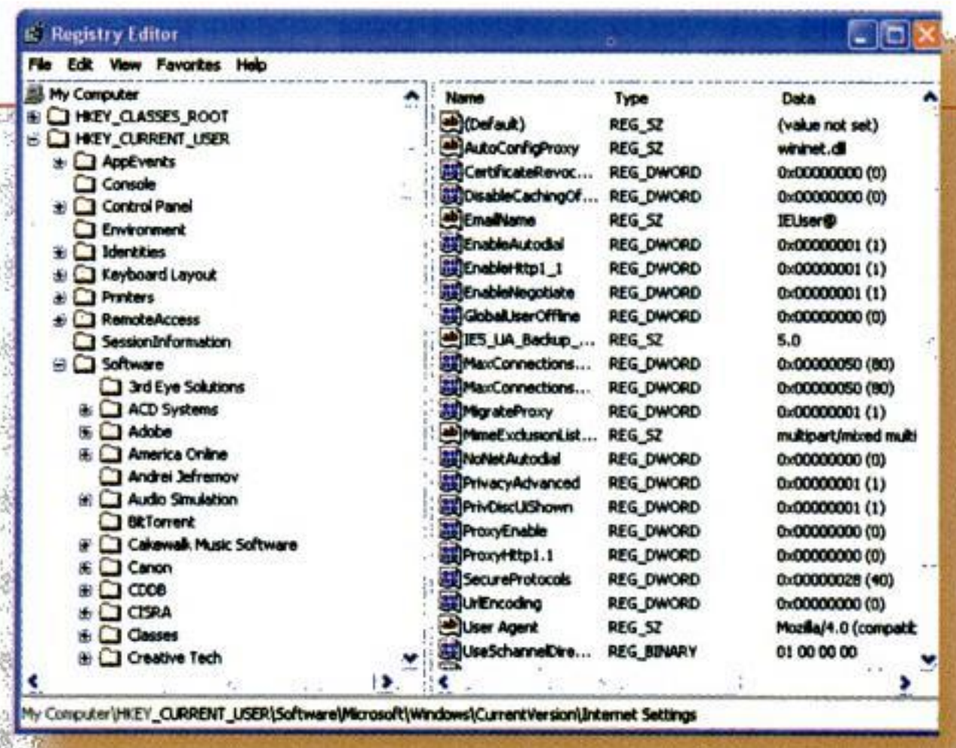
Q: What is the registry?

A: The registry is a Windows database that operates behind the scenes, storing information about everything happening with your computer. Whenever you make a change to your computer, from installing new software to changing your desktop background, the change is flagged in the registry.

The registry is hierarchical in structure, similar to the branch/tree structure used in hard drives. The main branches are called "Hives," and the Hives contain "Keys." Within the Keys are values that reflect the actual data stored in the registry.

Essentially, the registry is the Wizard of Oz that's behind the Windows graphical user interface you see every day. Believe us, you don't want to see the wizard unless it's absolutely necessary! It's not a pretty sight, so unless you know what you are doing, it's best to leave the registry alone.

You can access the registry by clicking on Start Menu, Run, and typing "regedit." Proceed with caution!



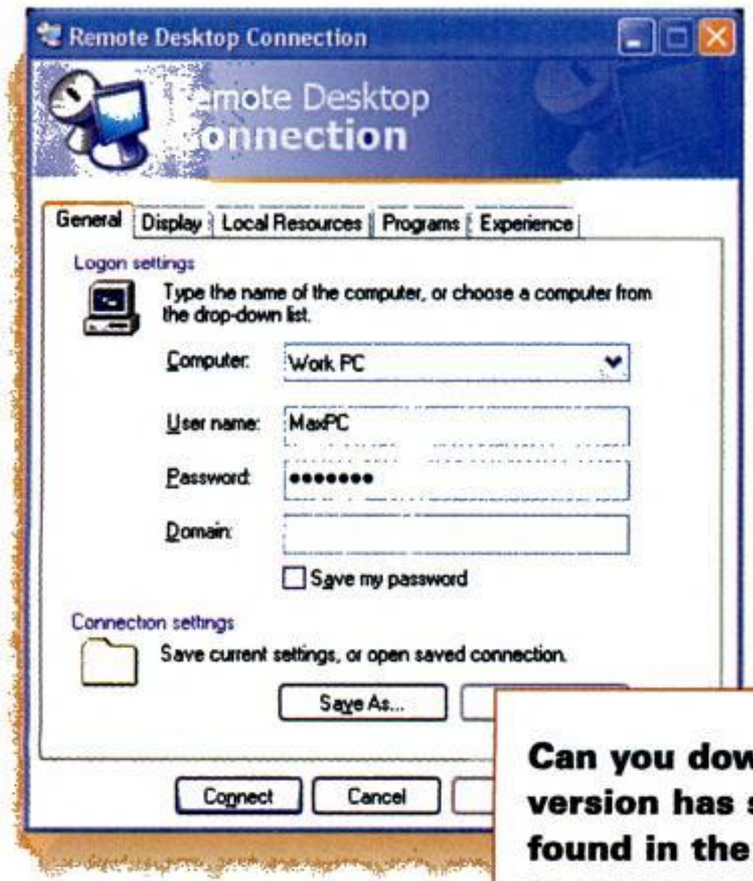
Behold, the Windows registry. Every time you make a change, install a program, or tweak a setting in your OS, it shows up here as a value.

Q: What is the difference between XP Professional and Home?

A: Windows XP comes in two flavors: Professional and Home. These versions are extremely similar, but Professional has a few extra features that may be interesting to some folks.

The first extra feature of the Pro version is Remote Desktop, which allows users to remotely access their Windows XP Professional PC from another computer. Windows XP Professional also has multiple-processor support, which the Home edition lacks. XP Pro has superior, but more complicated, security features compared with those featured in XP Home. For example, access control allows the user to restrict access to certain files and folders. The file system itself can be encrypted to prevent data theft. Pro also lets the user set up an FTP server, which is like an online database of files that other people can access at the user's discretion.

Overall, the extra features are worth the extra dough, in our opinion. To make your own decision, take a look at Microsoft's comparison guide here: **http://www.microsoft.com/windowsxp/pro/howtobuy/choosing2.asp**



Can you download me now? XP's Professional version has several "advanced" features not found in the Home version, such as the ability to connect to your PC remotely.

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CUSTOMIZE Windows XP

Windows XP is Microsoft's best operating system yet, but that doesn't mean it's perfect. These tips and tricks let you put your stamp on it and make it easier to use!

Tip One

Customize your account icon

If you don't like Microsoft's default image for your account screen, you can easily change it by going to Start Menu, Control Panel, User Accounts. Click on the account you want to change and select "Change my picture." From there you can choose a different image from the prefab ones listed or select your own. XP will resize it automatically. This image appears on the Welcome screen for your account as well as at the top of the Start Menu. We've selected a picture of our cat to reside atop our Start menu. Isn't he cute?

Ditch the Windows pre-fab picture for your account with something better, like one of your cat!

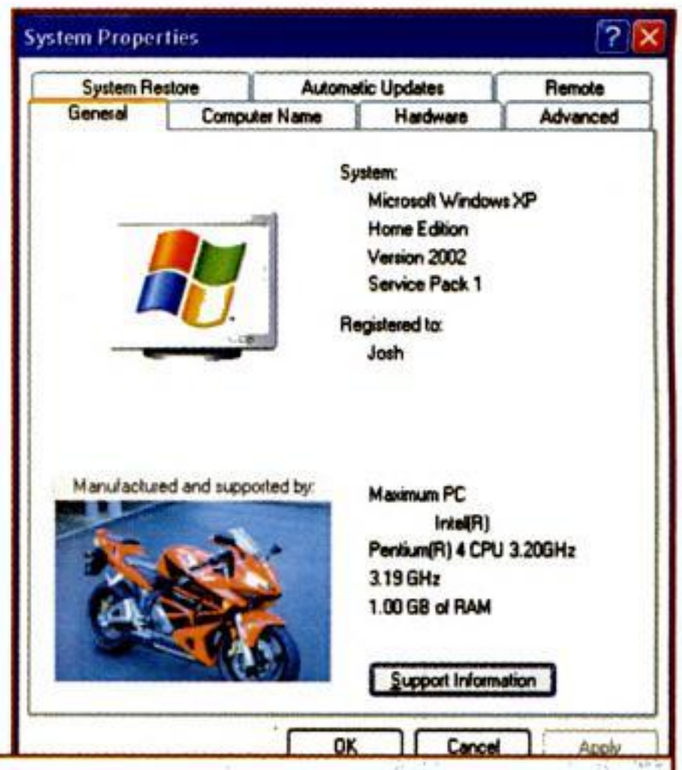
Tip Two

Add an image to your System Control Panel

You can display any picture you like along with custom text in the system control panel by following these easy steps. First, take your image and resize it to approximately 125 by 125 pixels (you can do this with *PaintShop Pro*, which is on the disc!) and save it as "oemlogo.bmp" and copy it to C:\Windows\System32. Next, open Notepad by clicking Start Menu, All Programs, Accessories, Notepad. Type the following:

[General]
Manufacturer=
Model=
[Support Information]
Line1=
Line2=
Line3=

Simply fill in the lines after the equals signs, and save it as "oeminfo.ini" in the C:\Windows\System32 folder. Now, right-click on My Computer and select "properties" to see your new image!



Manufacturers usually put their logo here, but you can put your own image here too!

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Tip Three

Add album art to your music folders

If you've got a lot of MP3s stuffed away in folders organized by album name, it can be a lot easier to find them using album art instead of folders. To achieve this effect, simply go to **www.amazon.com** and find the album you want to customize. Right-click on the little image displayed on the page for the album and select "Save As." Save it in the folder that includes the MP3s for that album, and name it "folder.jpg." Now the folder will display the thumbnail image instead of the boring folder icon. This also works for you're My Pictures folder as well! Note that this tip only works in "thumbnail" view (View, Thumbnails).

Rename any image inside a folder to "folder.jpg" and it will appear instead of the folder icon.

Tip Four

Customize the "Save To" locations for faster saves

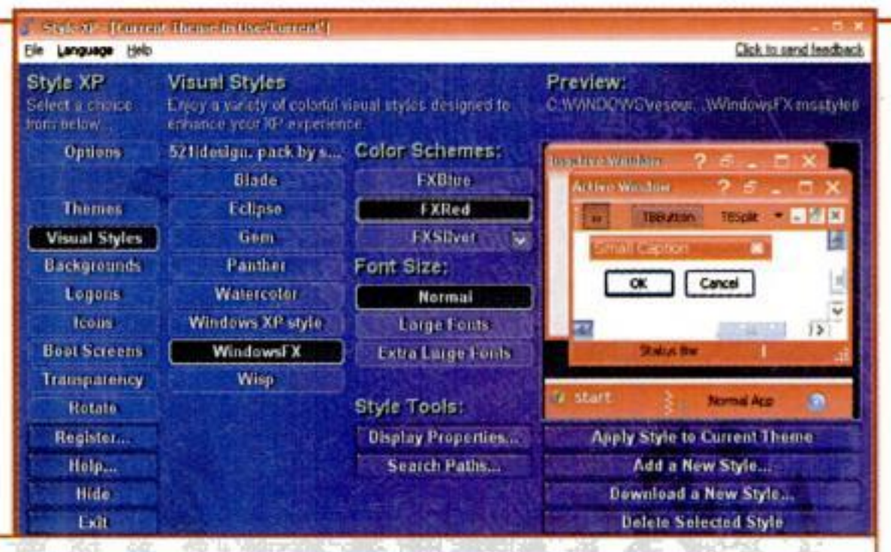
In XP, whenever you try to save something a dialog box opens up with several locations on the left-hand side for quick access. This is a handy feature, but the locations Microsoft has chosen for you are mostly irrelevant. To choose your own locations, we'll have to do the following. Go to www.Microsoft.com/powertoys and click on the link to Powertoys for Windows XP. This is a set of 12 XP enhancements made by Microsoft that are absolutely useful. Download and install *TweakUI* (and the others; they're all great!) and open the program. Go to "Common Dialogs" and click "Places Bar," and then "Custom Places Bar." You can now select from the drop-down list of common locations or type in the location to a file or folder manually.

Discard Microsoft's "places" for your own selection of frequently used folders with TweakUI.

Tip Five

Give Windows a whole new look

If you're not satisfied with the default blue, green or silver theme colors offered in XP, a nifty little program called *StyleXP* can open up an entirely new universe of appearance options. First, go to **www.tgtsoft.com**, then download and instlal *StyleXP*. Second, go to **www.themexp.org** and select any of the Visual Styles that tickle your fancy. You can choose from entire desktop themes, or just individual elements too. Once downloaded, unzip them to C:\Windows\Resources\Themes. Now you can select them from the Display properties section of the control panel under "appearance."

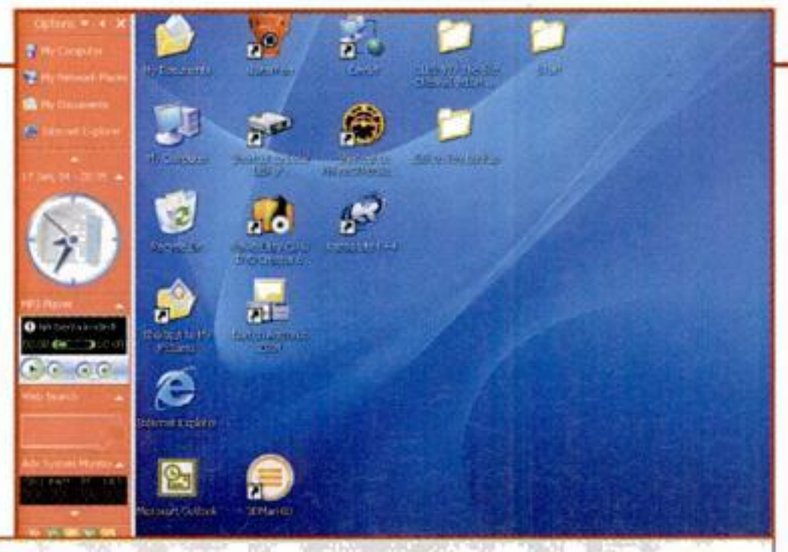


***StyleXP* is a handy utility for giving Windows XP a complete makeover.**

Tip Six

Don't wait for Longhorn, get a Sidebar now!

The next version of Windows will include a Sidebar, which is a quick launch bar that is docked to the side of your screen. Luckily, there's a freeware version available now that displays the time, performs Quick Launch functions and includes tickers for everything from ebay to your Hotmail account to CNN. It can also display memory, CPU, swap file and network activity and is completely customizable. It's on the CD included with this magazine in the "Apps" section under *SmartbarXP*. Give it a shot!



Why wait for Windows Longhorn to arrive in 2006 when you can have one of its coolest features—the sidebar—now?

Ask the Doctor

Your PC is sick, we've got the cure

MY START MENU IS A BIG MESS

What's the best way to organize the programs in my Start menu? I'd like to group all my games and Office XP applications together, if possible.

A: The easiest way to organize the Start menu in XP is to just drag-and-drop things where you'd like them to be. To drag things around inside the Start menu, click the Start button, go to All Programs, then left-click and hold down the mouse button over the shortcut you want to move. Then you can drag the shortcut wherever you want to put it. Unfortunately, this is a tedious process.

If you want to speed things up, you can right-click the Start button, select Explore, then right-click the Start button again and click Explore All Users. You should have two windows open now: The window that opened when you clicked Explore All Users displays the shortcuts that appear for every user of the PC, while the other window shows only the shortcuts that are exclusive to you.

You can now drag, drop, and create new folders just like in any other Explorer window. If you're using a shared computer, be sure to only make changes to the files in your personal folder rather than to those in the "all users" folder.

SPYWARE BE GONE!

What's the best way to get rid of spyware and adware?

A: Spyware, adware, and scumware are apps that hide on your system and perform various nefarious actions without your knowledge. There are several different free apps available that can help rid your PC of spyware for good.

Ad-Aware **(on the disc) has been the front-runner for a long time, but its definitions (similar to virus definitions used by an antivirus program) are updated infrequently, it seems. These days, we really like *Spybot*** **(also on the disc). It works much like *Ad-Aware*, but also includes the ability to clear the history from many popular apps. The developers who made *Spybot* also update the spyware definitions much more regularly than Lavasoft has lately.**

The Windows XP Start menu can get wily in no time! Tame it by creating new folders for groups of applications, such as "Games" and "Utilities."

MESSENGER MESSAGES ARE DRIVING ME MAD

I have a home LAN using Windows XP Home edition. My family and I will be playing online games or watching a movie in the living room when, all of a sudden, we get a pop-up message on our desktop. Can I fix this problem without resorting to third-party software?

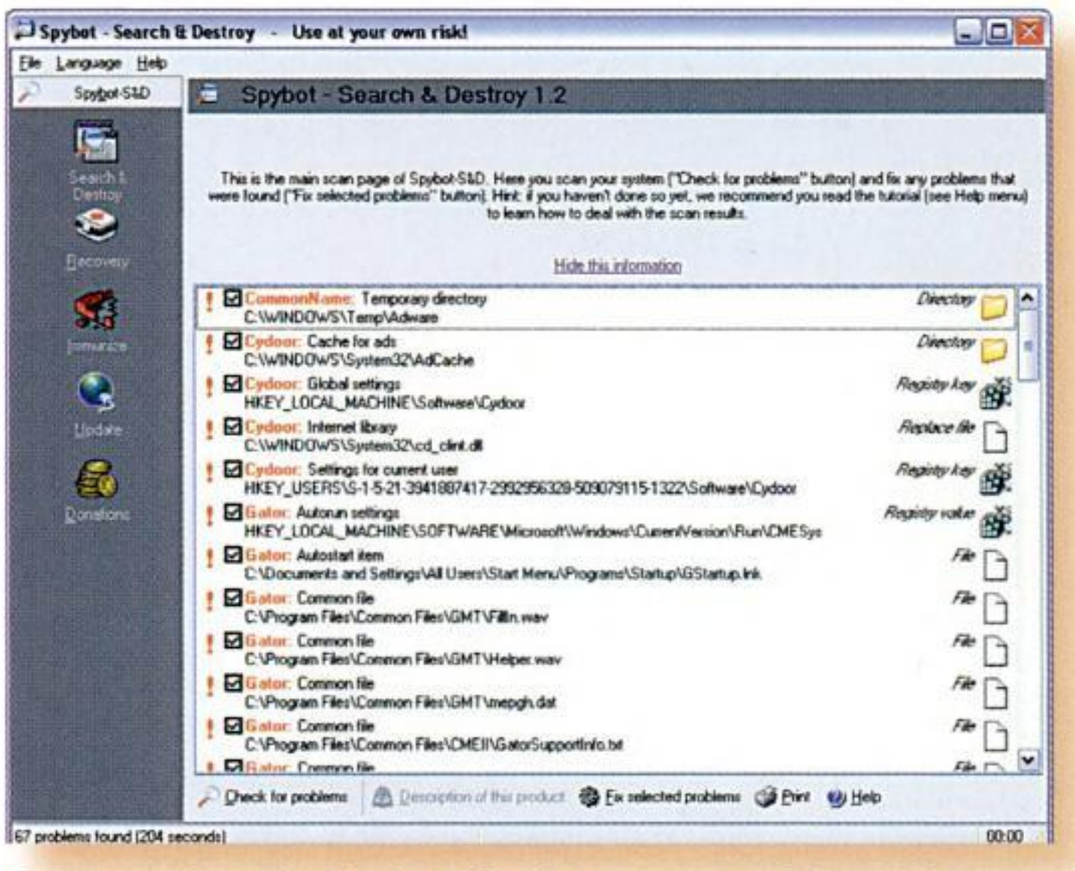
A: The Windows Messenger service—not to be confused with Windows Messenger, the IM client—is the latest front in the war against spam. Luckily, these messages can be stopped by activating XP's built-in firewall.

All you need to do is open up the Properties for your Internet connection, go to Start->Control Panel->Network Connections, and then right-click the icon for your Internet connection. (If you use a cable modem or DSL, it will probably be a Local Area Connection, but if you use an analog modem it will be named after your ISP.) Click Properties, then click the Advanced tab. Check the box labeled "Protect my computer and network by limiting or preventing access to this computer from the Internet."

DOUBLE DISKS?

Can I install Windows XP to two of my home computers, or do I have to purchase two installation disks?

Unfortunately for consumers, Microsoft's licensing rules for Windows XP allow the OS to be installed on only one machine at a time. However, if you already have a copy of XP and want to upgrade another machine, you can save a few bucks by buying an extra license without the CD and manuals. You can order additional licenses for XP Home and Professional at http://shop.microsoft.com/. A Home upgrade costs $84 and a Professional upgrade costs $184.



Spyware is probably installed on your machine right now, tracking what you do on your PC and reporting back to its creator. Nuke it from orbit with *Spybot*.

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Not all gamers
are equally
equipped.

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The way it's meant to be played

NVIDIA® GeForce FX™ Graphics
deliver blazing cinematic gaming effects

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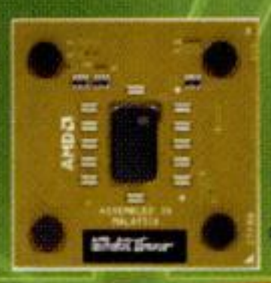

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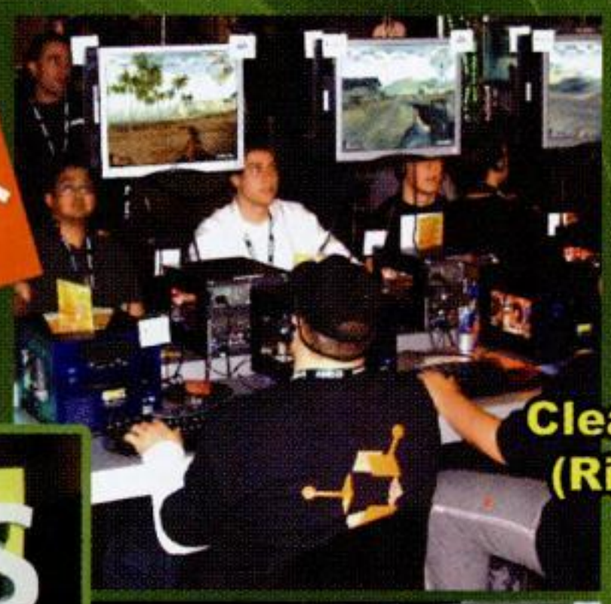
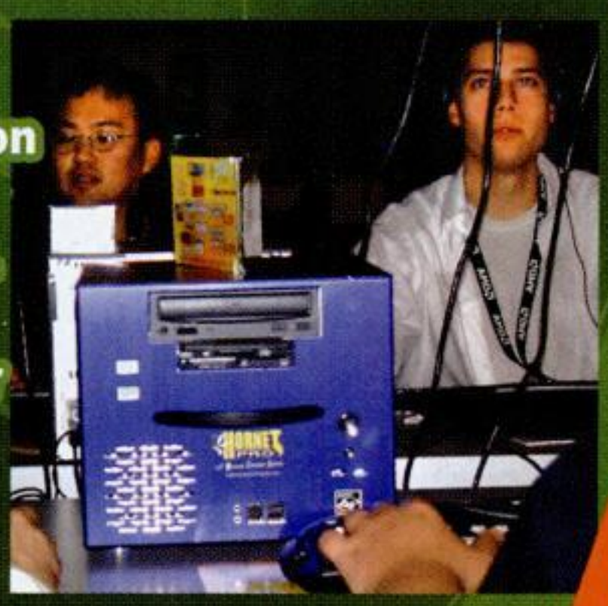


The Hornet Pro was featured in the AMD booth at the CyberX Games during CES 2004 in Vegas this January!



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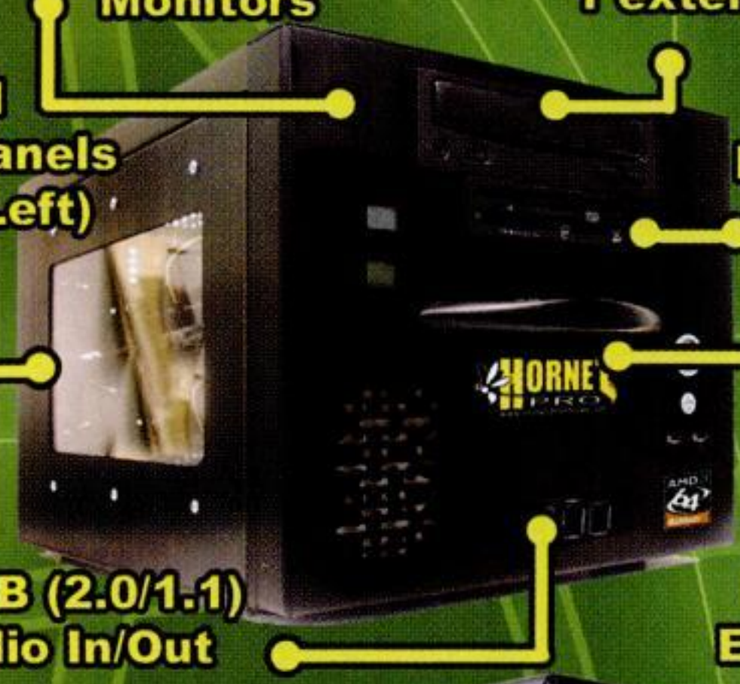

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We've prepared 20 questions, and each question has a one-word answer. Do your best and tally your score. Once tallied, find your tier on the right-hand side. We're sure you'll do fine, and we welcome you to our ranks!

1 The fastest iteration of the AGP spec is:

2 A Blu-ray disc holds how much data?

3 If a monitor's refresh rate is set to 80Hz, what will be your fastest 3D gaming frame rate?

4 The core processor of a videocard is known by this three-letter acronym:

5 What is the code-name of the newest iteration of the Pentium 4 processor?

6 How many Serial ATA drives can be run on each individual channel?

7 Memory that can transmit data on the rising and falling edges of its clock is known as:

8 If you wanted to look up temperature thresholds for your Intel processor, you'd look on the CPU for the:

9 The dark art of increasing your processor speed is called:

10 When burning a DVD, the best format to ensure capability with set-top players is:

11 A soundcard's onboard processor is known by this three-letter acronym:

12 This kind of paste is used to transfer heat between a CPU and its heatsink/fan assembly:

13 When a computer is turned on, the first thing it does is execute this program from the motherboard's ROM chip:

14 What is the fastest throughput rate spec for parallel ATA hard drives?

15 On an IDE channel, if one device is set as the Slave, the other must to be set as:

16 The fastest ATA hard drives on the market spin their platters at this many rpms:

17 There are two types of digital outputs from a soundcard; Optical and this kind:

18 This motherboard chip is responsible for communication between the CPU and main memory:

19 This file system, used by Windows XP, is represented by this four-letter acronym:

20 The software built into an optical drive that can be updated or "flashed" is called:

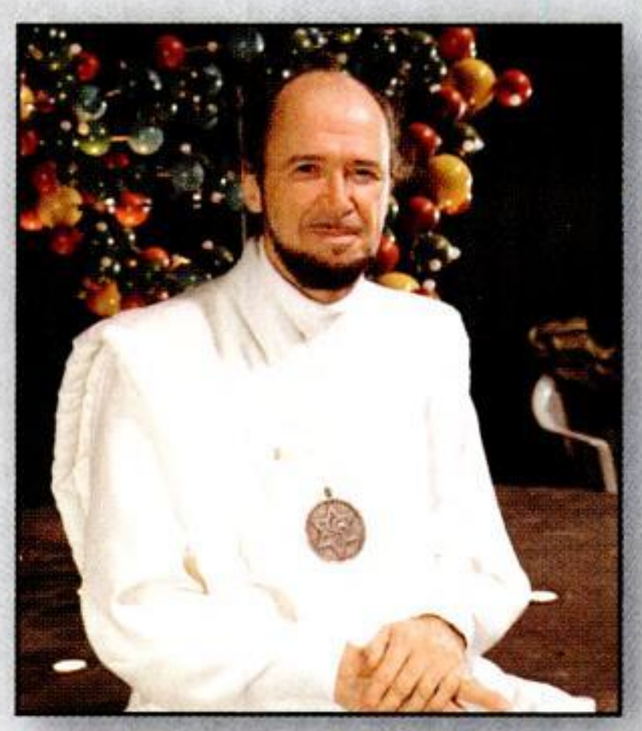
Answers: 1. 8x, 2. 27GB, 3. 80fps, 4. GPU, 5. Prescott, 6. One, 7. DDR, 8. S-Spec, 9. Overclocking, 10. DVD-R/RW, 11. DSP, 12. Thermal, 13. BIOS, 14. 133, 15. Master, 16. 10,000, 17. Coaxial, 18. Northbridge, 19. NTFS, 20. Firmware.

Tier 1 Geekdom
Zero to 10 correct answers

A Tier 1 geek is a newbie, a rank beginner, and a tech virgin, all wrapped up into one. Hit the books soldier!

Tier 2 Geekdom
11 to 15 correct answers

Well done, chap! A Tier 2 geek knows his CPUs from his GPUs, but still has a lot of work to do to make it to Tier 3.



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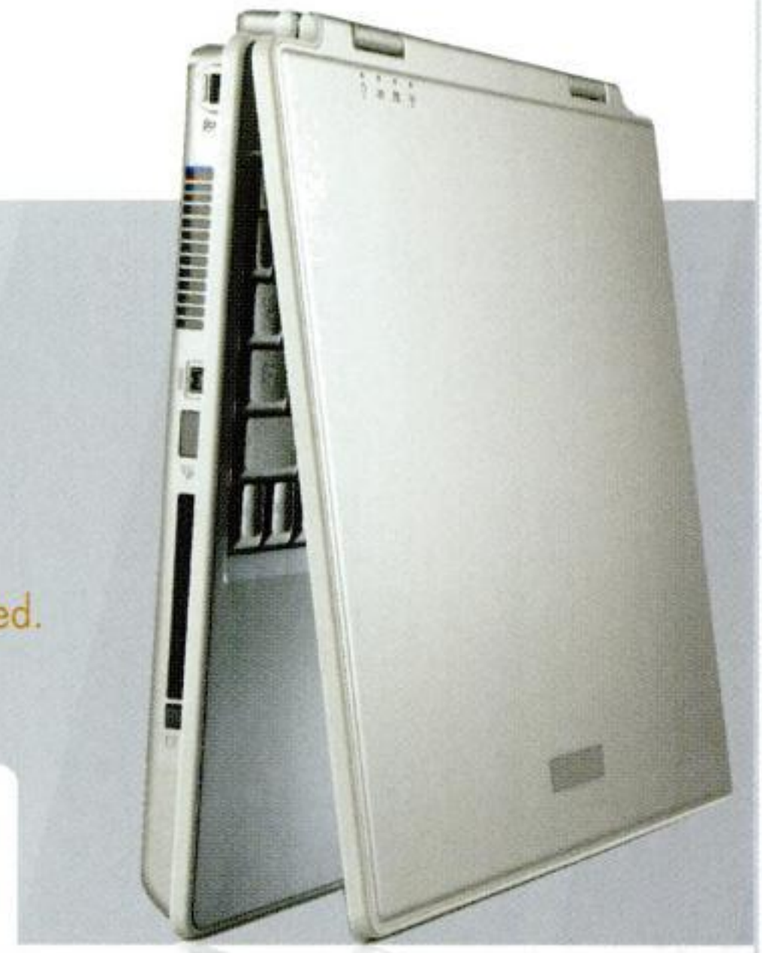

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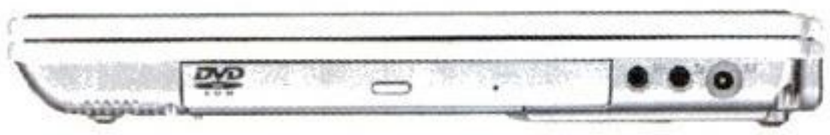

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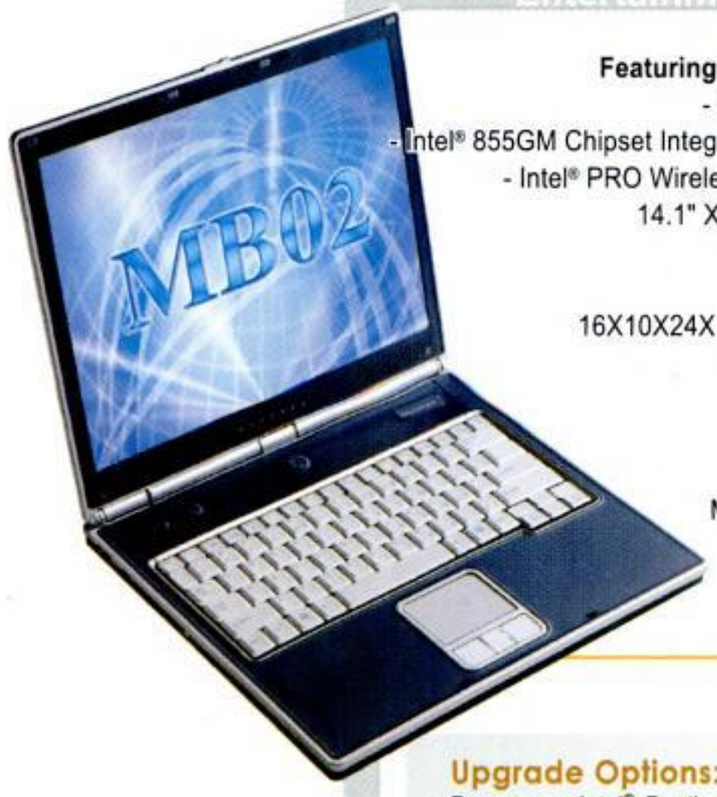

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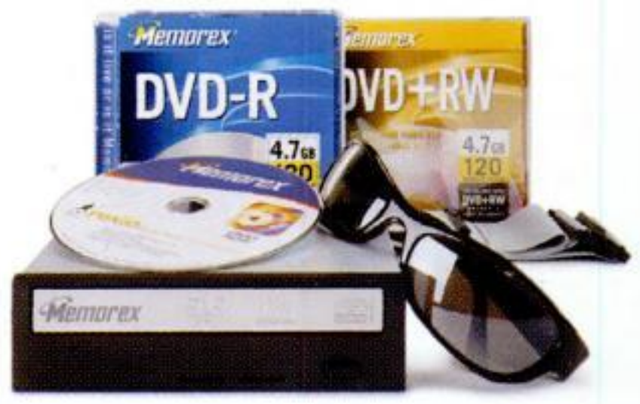

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